AUTOMOTIVE TESTING AND DIAGNOSIS

Student Handbook

Sun ELECTRIC CORPORATION

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ENGINE PERFORMANCE AND TESTING QUIZ

1. The basic function of valve overlap is:

   A. To prevent valve burning
   B. To improve volumetric efficiency
   C. To provide smoother idle
   D. To provide easier starting

2. How many crankshaft revolutions are required to complete one engine cycle in a four stroke cycle engine?

   A. One
   B. Two
   C. Three
   D. Four

3. To fire all of the cylinders in an eight cylinder four stroke cycle engine once, the crankshaft must complete:

   A. One revolution
   B. Two revolutions
   C. Four revolutions
   D. Sixteen revolutions

4. Cranking vacuum test indicates the condition of the:

   A. Charging system
   B. Carburetor and fuel pump
   C. Mechanical condition of the engine
   D. Vacuum diaphragm

5. Four factors that determine the electrical resistance of a length of wire are:

   A. Cross section, insulation, material, and diameter
   B. Temperature, length, material, and insulation
   C. Material, length, cross section, and temperature
   D. None of the above

6. Voltage drop is:

   A. Battery open circuit voltage between full charge and discharge
   B. Voltage expended in pushing a current through a resistance
   C. Another term for a short circuit
   D. Another term for an open circuit

7. How many sparks per minute occur at #1 spark plug at 1000 crankshaft rpms on an eight cylinder four stroke cycle engine?

   A. 250
   B. 500
   C. 1000
   D. 2000

8. The voltage normally encountered by an ignition condenser when the distributor breaker points open is approximately:

   A. 6 volts
   B. 250 volts
   C. 4000 volts
   D. 14,000 volts

9. An ammeter is placed in a circuit in:

   A. Series
   B. Parallel
   C. Shunt
   D. Parallel shunt

10. Ignition voltage requirements are:

   A. Highest with lean mixture
   B. Highest with rich mixture
   C. Lowest with lean mixture
   D. Mixture does not affect voltage requirements

11. A distributor rotor tip that is changed in shape by being burned:

A. Will advance timing
B. Will retard timing
C. Affects timing only at high speed
D. Will not affect timing

12. Which condenser stores the greater amount of electrical energy?

A. .100 microfarad
B. .32 microfarad
C. .25 microfarad
D. .5 microfarad

13. A five degree change in dwell will cause a change in ignition timing of:

A. 2 1/2 degrees
B. 5 degrees
C. 10 degrees
D. No change will occur

14. As the rubbing block on the contact points wears:

A. Dwell angle increases and point gap increases
B. Dwell angle increases and point gap decreases
C. Dwell angle decreases and point gap increases
D. No change occurs

15. For efficient ignition system operation, the polarity of the secondary ignition circuit should be:

A. Positive ground
B. Negative ground
C. Alternately negative and positive
D. Does not affect ignition efficiency

16. During the cranking operation, a 12 volt battery should be able to maintain at least:

A. 12.6
B. 9.8
C. 9.6
D. 8.9

17. Voltage is:

   A. Electrical pressure
   B. A unit of electrical horsepower
   C. A unit of resistance
   D. Caused by eddy current

18. An Ohm is a measurement of:

   A. Electrical pressure
   B. Electrical flow
   C. Electrical resistance
   D. Electrical capacity

19. To properly adjust initial (basic) ignition timing what two instruments are needed?

   A. Timing light and dwell meter
   B. Vacuum gauge and timing light
   C. Distributor tester and dwell meter
   D. Tachometer and timing light

20. Frayed or worn conductor insulation will cause high resistance in:

   A. Primary circuit
   B. Secondary circuit
   C. Any electrical circuit
   D. No electrical circuit

21. Fuel pumps may be checked for:

   A. Volume
   B. Pressure
   C. Vacuum
   D. All of the above

22. Carburetor idle mixture should be adjusted ________________ the ignition timing has been set.

   A. Before
   B. After
   C. Makes no difference
   D. While

23. A cracked intake manifold may cause:

A. Rich mixture

B. Noticeable drop in oil pressure

C. Lean mixture

D. No change

24. The intermediate section of the scope pattern of a standard ignition system indicates the condition of the:

A. Spark plugs

B. Coil and condenser

C. Ballast resistor

D. Ignition points

25. Too much valve tappet clearance will cause valves to:

A. Open late and close late

B. Open early and close late

C. Open late and close early

D. Open early and close early

26. Six areas of engine testing are:

A. Starting, charging, carburetor, fuel, ignition, emissions

B. Battery, starting, charging, ignition, fuel, emissions

C. Battery, starting, charging, ignition, compression, emissions

D. Starting, compression, fuel, ignition, charging, emissions

27. **Breaker** points are aligned by bending the:

A. Movable points arm

B. Movable points arm pivot post

C. Stationary point bracket

D. Is not adjustable

28. Mechanic A says the Exhaust Gas Recirculation (EGR) system is used to reburn some of the exhaust gases and in this way cut down on the amount of exhaust gas getting into the atmosphere.

Mechanic B says the EGR system is used to recirculate exhaust gas into the combustion chambers to limit the high combustion temperatures where NOx (nitrogen oxide) is produced.

A. A only

B. B only

C. Both A and B
D. Neither A or B

29. Distributor centrifugal (mechanical) advance action is governed by:

A. The speed of the engine
B. Engine vacuum
C. The breaker point gap
D. The engine load conditions

30. Distributor vacuum advance action is governed by:

A. The number of cylinders in the engine
B. Breaker plate movement
C. The load of the engine
D. The speed of the engine

31. A faulty valve in the positive crankcase ventilation system will:

A. Affect idle stability
B. Decrease exhaust emissions
C. Increase gasoline mileage
D. All of the above

32. Radio and TV suppression type resistor spark plug cables:

A. Increase the voltage required to fire the spark plugs
B. Are used only with resistor type spark plugs
C. Must be carefully handled to avoid internal cable damage
D. Must have more than 100,000 ohms resistance to be considered satisfactory

33. Fuel pump pressure is controlled by the:

A. Speed of the engine
B. Size of the pump
C. Tension of the diaphragm spring
D. Length of diaphragm stroke

34. Coil output is maximum while running the engine when the:

A. Secondary circuit is opened by disconnecting a plug wire

B. Rotor is shorted

C. Spark plugs are fouled

D. Plug wire is grounded with a test prod

35. When operating under a heavy load or wide open throttle, the power system of a carburetor must be able to supply:

A. Leaner mixtures

B. More vacuum

C. Richer mixtures

D. More pressure

36. A typical 12 volt charging system voltage regulator should be adjusted for an operating voltage of:

A. 12 volts

B. 12.0 - 12.5

C. 12.5 - 13.5

D. 13.5 - 15.3

37. The carburetor operates on the principle of:

A. Atmospheric pressure

B. Fuel pump pressure

C. Differential pressure

D. Positive pressure

38. Which is part of the primary ignition circuit?

A. Breaker points

B. Distributor cap

C. Distributor rotor

D. Spark plugs

39. Mechanic A believes that air is injected into the exhaust manifold to continue the burning of exhaust gases and in this way cut down on the amount of pollutants released through the tail pipe.

Mechanic B says the air injection system is used to neutralize the back pressure in the exhaust system of modern engines using emission control devices.

A. A only

B. B only

C. Both A and B

D. Neither A or B

40. Ignition condensers should be checked for:

A. Current draw, molecular capacity, parallel resistance
B. Electrical capacity, electrical leakage, parallel resistance
C. Electrical capacity, series resistance, electrical leakage
D. Electrical capacity, parallel resistance, current draw

NAME ____________________

DATE ____________________

ENGINE PERFORMANCE AND TESTING QUIZ
ANSWER SHEET

No. right ______

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D
10. A B C D
11. A B C D
12. A B C D
13. A B C D
14. A B C D
15. A B C D
16. A B C D
17. A B C D
18. A B C D
19. A B C D
20. A B C D
21. A B C D
22. A B C D
23. A B C D
24. A B C D
25. A B C D
26. A B C D
27. A B C D
28. A B C D
29. A B C D
30. A B C D
31. A B C D
32. A B C D
33. A B C D
34. A B C D
35. A B C D
36. A B C D
37. A B C D
38. A B C D
39. A B C D
40. A B C D

TWO QUESTION SURVEY

QUESTION NO. 1

What steps or procedures do you now perform for a complete tune up? List these steps below.

QUESTION NO. 2

What tests would you perform to find the cause of a hesitation in acceleration? List these tests below.

SUN — 2001

COMPUTER DIAGNOSIS TEST REPORT

Customer Name ______________ Phone ______________ Date ______________
Address ______________ City/State ______________ License ______________
Make/Year/Model ______________ Mileage ______________ Mileage Since Tune-Up ______________
Engine ______________ Transmission — Auto ☐ Std ☐ Air Conditioning — Yes ☐ No ☐
Carburetor ______________ Ignition Type ______________ Air Pump — Yes ☐ No ☐ Converter — Yes ☐ No ☐
Reason For Tests ______________ Tested By ______________

TEST MODE	TESTS	READ	ENTER SPECIFICATIONS		TEST RESULT	GO	NO GO
#1 CRANKING	BATTERY	COMPUTER	VOLTS (MIN)				
	STARTER DRAW	COMPUTER	AMPS (MAX)				
	CRANKING SPEED	COMPUTER	RPM				
	DYN. DIST. RES.	COMPUTER	VOLTS (MAX)				
	DWELL	COMPUTER	DEG.				
	REL. COMPRESSION	COMPUTER	%				
	COIL OUTPUT	COMPUTER	KV (MIN)				
	CRANKING VACUUM	VACUUM GAUGE	STEADY				
#2 ALTERNATOR OUTPUT	PEAK TEST SPEED	COMPUTER	APPROX. RPM	2500			
	ALTERNATOR CHECK	COMPUTER	AMPS	SHOWS CHARGE			
#3 IDLE	ENGINE SPEED	COMPUTER	RPM				
	DWELL	COMPUTER	DEG				
	CARBON MONOXIDE	COMPUTER	%				
	HYDROCARBONS	COMPUTER	PPM				
	INITIAL TIMING	COMPUTER	DEG.				
	MANIFOLD VACUUM	VACUUM GAUGE	INCHES (MIN)				
	PCV TEST	RPM & VAC. GAUGE	INCHES				
#4 LOW CRUISE	(SET ENGINE SPEED)	COMPUTER	APPROX. RPM	1500			
	CARBON MONOXIDE	COMPUTER	%				
	HYDROCARBONS	COMPUTER	PPM				
	IGN. SECONDARY - REQ	COMPUTER	KV (MIN)				
	IGN. SECONDARY - REQ	COMPUTER	KV (MAX)				
	COIL POLARITY	SCOPE (DISPLAY)	VISUAL	▨			
		SCOPE (DISPLAY)	KV (MIN)				
	SECONDARY INSULATION	SCOPE (DISPLAY)	VISUAL	▨			
	SECONDARY RESISTANCE	SCOPE (RASTER-SHIFT)	VISUAL	▨			
	COIL & COND. CONDITION	SCOPE (RASTER-SHIFT)	VISUAL	▨			
	BREAKER POINT COND.	SCOPE (RASTER-SHIFT)	VISUAL	▨			
	CAM LOBE ACCURACY	SCOPE (RASTER-SHIFT)	VISUAL	▨			
	ALTERNATOR CONDITION	SCOPE (SPEC. PATTERNS)	EVEN RIPPLE				
	MANIFOLD VACUUM	VACUUM GAUGE	INCHES (MIN)				
#5 AUTOMATIC POWER BALANCE	CYL. RPM CHANGE 1 2 3 4	COMPUTER 5 6 7 8	BASE SPEED	▨			
			EVENNESS				
#6 SNAP ACCELERATION	PEAK TEST SPEED	COMPUTER	APPROX. RPM	2500			
	CARBON MONOXIDE	COMPUTER	% (MAX)				
	PLUG NO.	COMPUTER	▨	▨			
	1 2 3 4	5 6 7 8	KV (MAX)				
#7 HIGH CRUISE	(SET ENGINE SPEED)	COMPUTER	RPM	2500			
	DWELL	COMPUTER	DEG				
	DWELL VARIATION	COMPUTER	DEG (MAX)				
	TIMING ADVANCE	COMPUTER	DEG.				
	INITIAL + ADVANCE	COMPUTER	DEG				
	CARBON MONOXIDE	COMPUTER	%				
	HYDROCARBONS	COMPUTER	PPM				
	CHARGING VOLTS	COMPUTER	VOLTS				
	MANIFOLD VACUUM	VACUUM GAUGE	INCHES				

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SUN TUT—915/915R

ENGINE PERFORMANCE TEST REPORT

Customer Name ______________________ **Phone** __________ **Date** __________

Address ______________________ **City/State** __________ **License** __________

Make/Year/Model ______________________ **Mileage** __________ **Mileage Since Tune-Up** __________

Engine __________ **Transmission—Auto** ☐ **Std** ☐ **Air Conditioning—Yes** ☐ **No** ☐

Carburetor __________ **Ignition Type** __________ **Air Pump—Yes** ☐ **No** ☐ **Converter—Yes** ☐ **No** ☐

Reason For Tests ______________________ **Tested By** __________

<table>
<tr><th></th><th>TEST MODE</th><th colspan="9">TESTS</th><th>READ</th><th colspan="2">ENTER SPECIFICATIONS</th><th>TEST RESULT</th><th>GO</th><th>NO GO</th></tr>
<tr><td>1.</td><td>CRANKING BATTERY VOLTAGE</td><td colspan="9">BATTERY, STARTING SYSTEM</td><td>VOLTMETER</td><td>VOLTS (MIN)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td>DWELL</td><td colspan="9">BREAKER POINT SETTING</td><td>DWELLMETER</td><td>DEGREES</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td>DWELL VARIATION</td><td colspan="9">DISTRIBUTOR MECH. COND.</td><td>DWELLMETER</td><td>DEGREES</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td>IDLE SPEED</td><td colspan="9">IDLE SPEED ADJUSTMENT</td><td>TACHOMETER</td><td>RPM</td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.</td><td>INITIAL TIMING</td><td colspan="9">SPARK TIMING SETTING</td><td>TIMING ADVANCE UNIT</td><td>DEGREES</td><td></td><td></td><td></td><td></td></tr>
<tr><td>6.</td><td>TIMING ADVANCE</td><td colspan="9">MECH. AND VAC. ADVANCE</td><td>TIMING ADVANCE UNIT</td><td>DEGREES</td><td></td><td></td><td></td><td></td></tr>
<tr><td>7.</td><td>COIL POLARITY</td><td colspan="9">COIL AND SYSTEM POLARITY</td><td>SCOPE (DISPLAY)</td><td>VISUAL</td><td>▨</td><td></td><td></td><td></td></tr>
<tr><td>8.</td><td>MAXIMUM COIL OUTPUT</td><td colspan="9">COIL, COND. IGNITION PRIMARY</td><td>SCOPE (DISPLAY)</td><td>KV (MIN)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>9.</td><td>SECONDARY CIRCUIT INSUL.</td><td colspan="9">HIGH TENSION WIRES, CAP, ROTOR</td><td>SCOPE (DISPLAY)</td><td>VISUAL</td><td>▨</td><td></td><td></td><td></td></tr>
<tr><td>10.</td><td>SPARK PLUG FIRING VOLTAGE</td><td colspan="9">WIRES, PLUG & ROTOR GAPS</td><td>SCOPE (DISPLAY)</td><td>VISUAL</td><td>▨</td><td></td><td></td><td></td></tr>
<tr><td>11.</td><td>SPARK PLUGS UNDER LOAD</td><td colspan="9">WORN OR FOULED SPARK PLUGS</td><td>SCOPE (DISPLAY)</td><td>KV (MAX)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>12.</td><td>SECONDARY CIRCUIT COND.</td><td colspan="9">PLUGS, WIRES, CAP, ROTOR RESISTANCE</td><td>SCOPE (RASTER)</td><td>VISUAL</td><td>▨</td><td></td><td></td><td></td></tr>
<tr><td>13.</td><td>COIL AND COND. CONDITION</td><td colspan="9">COIL WINDINGS, COND. LEAKAGE</td><td>SCOPE (RASTER)</td><td>VISUAL</td><td>▨</td><td></td><td></td><td></td></tr>
<tr><td>14.</td><td>BREAKER POINT CONDITION</td><td colspan="9">POINT CLOSE, BOUNCE, OPEN, ARC</td><td>SCOPE (RASTER)</td><td>VISUAL</td><td>▨</td><td></td><td></td><td></td></tr>
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<tr><td rowspan="3">16.</td><td rowspan="3">CYLINDER POWER BALANCE</td><td colspan="9">ENGINE</td><td>TACHOMETER</td><td>BASE RPM</td><td></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td rowspan="2">SHORTED RPM</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td colspan="3"></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="3"></td></tr>
<tr><td>17.</td><td>CHARGING VOLTAGE</td><td colspan="9">GEN. ALT. VOLT REG.</td><td>VOLTMETER</td><td>VOLTS</td><td></td><td></td><td></td><td></td></tr>
</table>

692-744-3 (6721)

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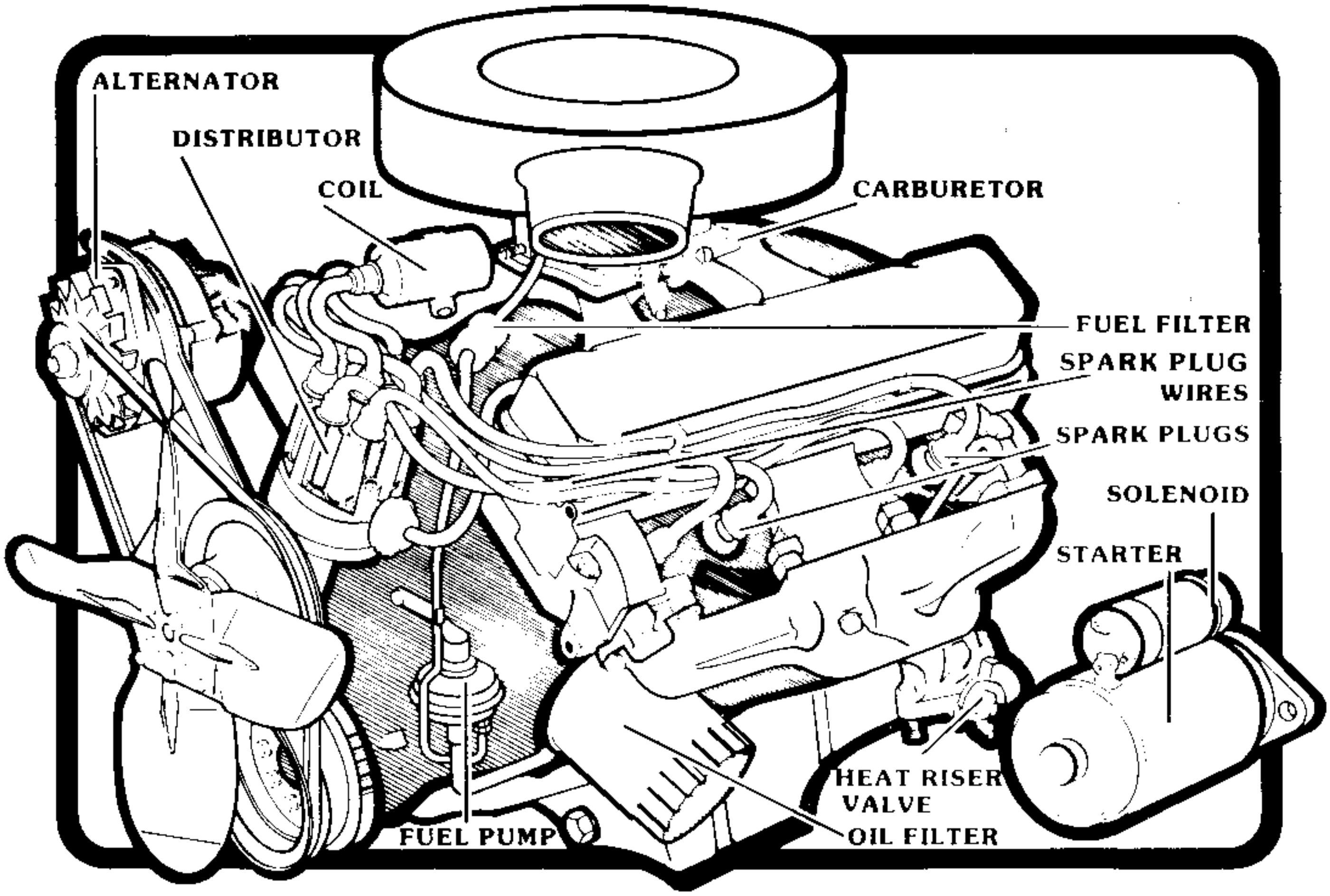


SERVICE RECOMMENDATIONS

STARTING AND CHARGING SYSTEM

Good	Service	Replace	
☐	☐	☐	Battery
☐	☐	☐	Battery Cables
☐	☐	☐	Starter
☐	☐	☐	Alternator
☐	☐	☐	Regulator
☐	☐	☐	Fan and Drive Belts

Other

IGNITION SYSTEM

Good	Service	Replace	
☐	☐	☐	Spark Plugs
☐	☐	☐	Points/Condenser
☐	☐	☐	Distributor Advance
☐	☐	☐	Distributor Cap
☐	☐	☐	Distributor Rotor
☐	☐	☐	Wires & Connections

Other

FUEL SYSTEM

Good	Service	Replace	
☐	☐	☐	Air Filter
☐	☐	☐	Choke
☐	☐	☐	Carburetor
☐	☐	☐	Fuel Filter
☐	☐	☐	Fuel Pump
☐	☐	☐	PCV Valve

Other

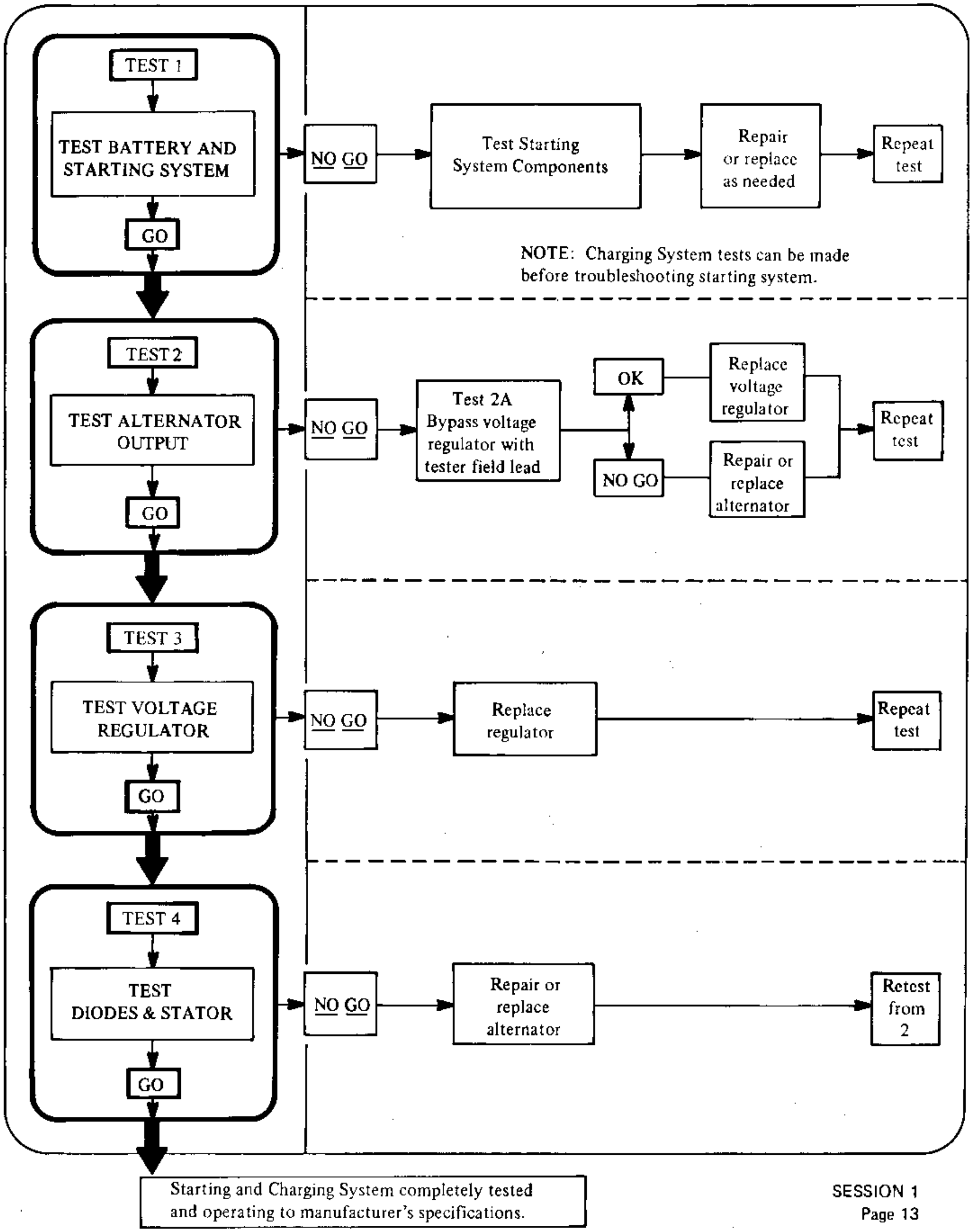
ENGINE MECHANICAL EVALUATION

☐ Good ☐ Compression and Cylinder Leakage Tests Needed

Estimate

Signature

SUN 2-MINUTE STARTING AND CHARGING SYSTEM CHECK USING THE VAT-40


TEST 1
TEST BATTERY AND STARTING SYSTEM
GO
NO GO
Test Starting System Components
Repair or replace as needed
Repeat test
TEST 2
TEST ALTERNATOR OUTPUT
GO
NO GO
Test 2A Bypass voltage regulator with tester field lead
OK
Replace voltage regulator
NO GO
Repair or replace alternator
Repeat test
TEST 3
TEST VOLTAGE REGULATOR
GO
NO GO
Replace regulator
Repeat test
TEST 4
TEST DIODES & STATOR
GO
NO GO
Repair or replace alternator
Retest from 2
Starting and Charging System completely tested and operating to manufacturer's specifications.

NOTE: Charging System tests can be made before troubleshooting starting system.

TESTING 6 AND 12 VOLT STARTING AND CHARGING SYSTEMS

Using Sun's VAT-40

This condensed procedure will detect starting and charging problems, using manufacturer's specifications with vehicle at normal operating temperature. Tests can be made under other conditions, but standard specifications will not apply. (Specifications shown here are for 12 volt systems.) For complete test information, consult the VAT-40 instruction manual.

CALIBRATION AND HOOKUP

All tests (except those requiring the use of the FIELD SELECTOR) can be made without disconnecting any vehicle leads because of the tester's clamp-on ammeter pickup. Ammeter readings will be accurate as long as the vehicle battery voltage is 4.5 volts or higher.

A. Check each meter's mechanical zero. Adjust if needed. See Figure 1.

B. Rotate the LOAD INCREASE control fully counterclockwise to "OFF."

C. Connect the tester LOAD LEADS to the battery terminals, Red to positive, Black to negative.

D. Set the VOLT SELECTOR to "INT. 18 V."

E. Set the TEST SELECTOR to #2 CHARGING position.

F. Adjust ammeter to read ZERO using the electrical ZERO ADJUST control.

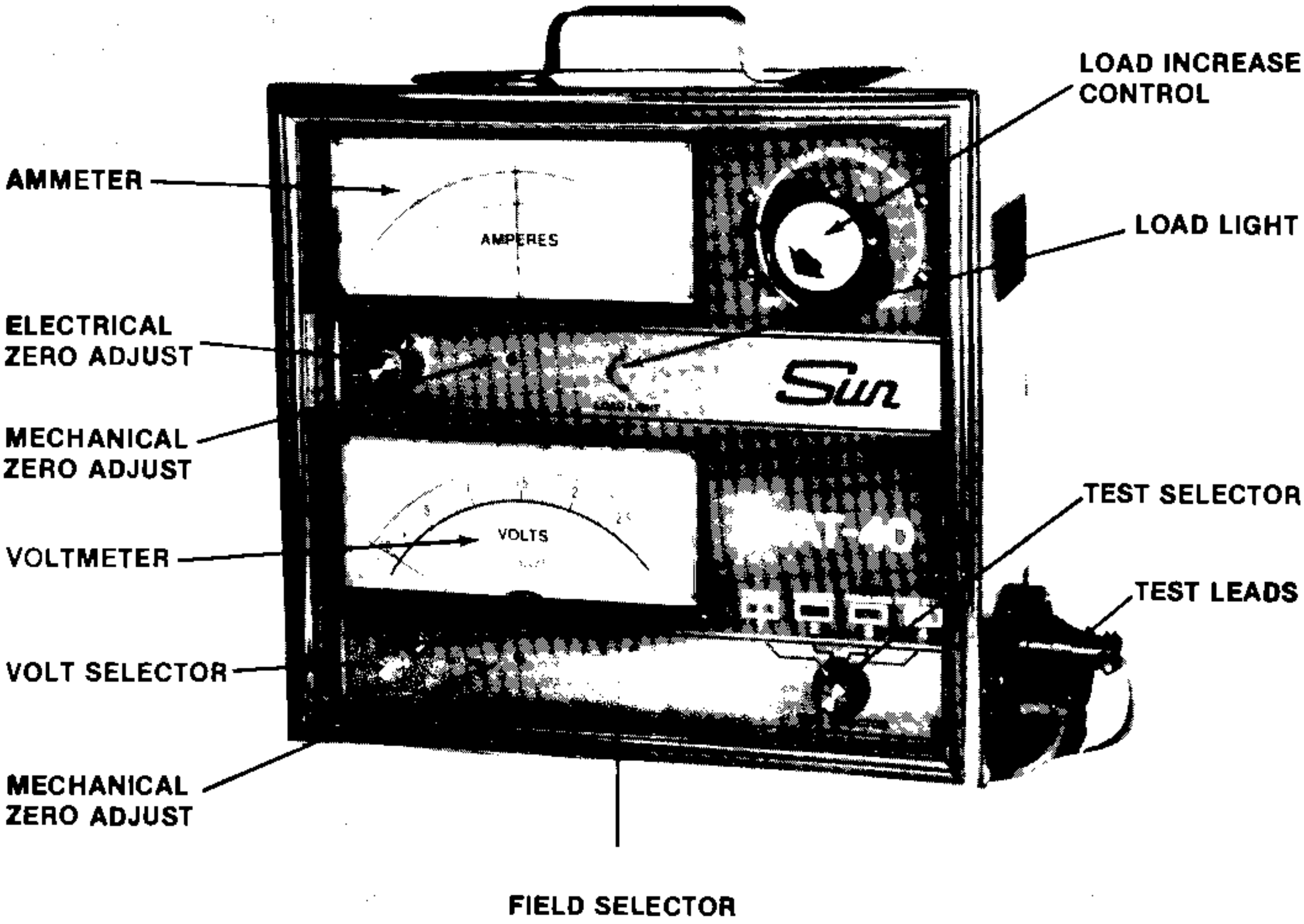


Figure 1—Volt Ampere Tester Model VAT-40.

TEST #1 STARTING

A. Battery Performance

1. Connect the Green clamp-on AMPS PICK-UP around either **tester** load cable (disregard polarity). See Figure 2, A.

2. Set the TEST SELECTOR to the #1 STARTING position.

3. Observing the Red Ammeter scale, turn the LOAD INCREASE control clockwise until the ammeter reads 3 times the battery ampere hour rating, or ½ Cold Cranking Current at 0° F.

   NOTE: If the test load cannot be reached and the battery voltage is below 9.6, the battery performance is poor. Perform Sun 3 Minute Battery Test, Sun #692-270.

4. Maintain load for 15 seconds and note Green Voltmeter scale reading. Then return LOAD CONTROL to off.

   Test Indications:

   a. Voltage with load applied is 10.0 or more, battery performance is GOOD. Battery is serviceable.

   b. Voltage with load applied is 9.6 to 9.9, battery is serviceable, and Starting System Test can be performed. However, battery needs further testing. Perform Sun 3 Minute Battery Test.

   c. Voltage with load applied is below 9.6 volts. Battery is either discharged or defective and further testing is needed. Perform Sun 3 Minute Battery Test.

   d. Test load cannot be reached. Perform Sun 3 Minute Battery Test.

B. Starting System

This test should be made only with a serviceable battery.

1. Turn off all lights and accessories and close all doors.

2. Connect the Green clamp-on AMPS PICK-UP around the **vehicle** ground battery cables. (Disregard polarity.) If more than one cable is connected to battery post, place clamp around all cables. See Figure 2, B.

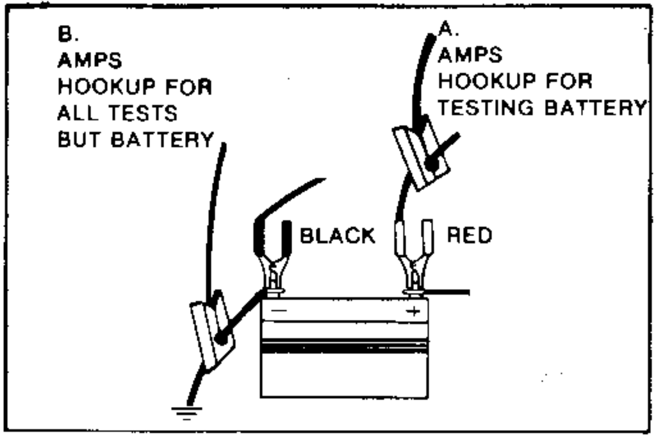


Figure 2—Test connections for Ammeter.

3. Leave the TEST SELECTOR in the #1 STARTING position.

4. Prevent the engine from starting during the cranking test.

   a. Gasoline engines with externally mounted ignition coil: Remove the coil high tension lead at the distributor center tower and connect the disconnected lead to engine ground.

   b. Gasoline engines with integral mounted ignition coil: Disconnect the ignition switch lead from the ignition system assembly. Do not allow lead to touch ground.

5. Crank engine while observing Green Voltmeter reading and Red Ammeter reading.

   Test Indications:

   a. Ammeter reading should not exceed maximum specified.

   b. Voltage should be at or above minimum specified.

   c. Cranking speed should be normal.

      NOTE: If no specification is available, a rule of thumb is:

      Starter current draw
        Large 8 cylinder engines—reading under 250 AMPS—OK

        Small 8 cylinder engines and 6 cylinder engines—reading under 200 AMPS—OK

Cranking Voltage
See manufacturer's specifications. If not specified, 9.6 volts or higher.

Experience and tests of good starting systems will provide the best test data when no specification is available.

GOOD — Within manufacturer's specifications.

BAD—Perform voltage drop tests of cables and solenoid to determine whether trouble is in the starter, cables, or solenoid.

6. Restore engine to starting condition.

TEST #2 CHARGING

A. Leave the Green clamp-on **AMPS PICKUP** around vehicle ground cable or cables. See Figure 2, B.

B. Set the **TEST SELECTOR** to the **#2 CHARGING** position.

C. Turn the ignition switch to the run position and read rate of discharge on the Ammeter.

D. Start engine and adjust speed to approximately 2000 rpm, or to manufacturer's specified test speed.

E. Adjust the LOAD INCREASE control slowly as required to obtain the highest reading on the Blue Ammeter scale. Do not drop voltage lower than 12 volts.

NOTE: For charging systems rated above 100 amperes use the #1 STARTING position and read the Red 0-500 amp scale.

F. Rotate LOAD INCREASE control to OFF.

G. Add the ammeter readings obtained in Steps C and E for total alternator output, and compare total to manufacturer's specification.

GOOD—Alternator/Generator output within 10% of manufacturer's specification. Proceed to Step #3.

BAD —Output not within 10% of specifications. Proceed to test #2A "Output Tester FIELD SELECTOR."

TEST #2A OUTPUT TEST USING TESTER FIELD SELECTOR

NOTE: This test is to determine if alternator or voltage regulator is bad and is only required if system fails Charging Test #2. The test is for alternator charging systems only. Refer to the instruction manual for testing DC charging systems.

A. Stop engine and disconnect the vehicle lead from the alternator field terminal (or disconnect the regulator connector plug if field terminal is inaccessible). See Figure 3.

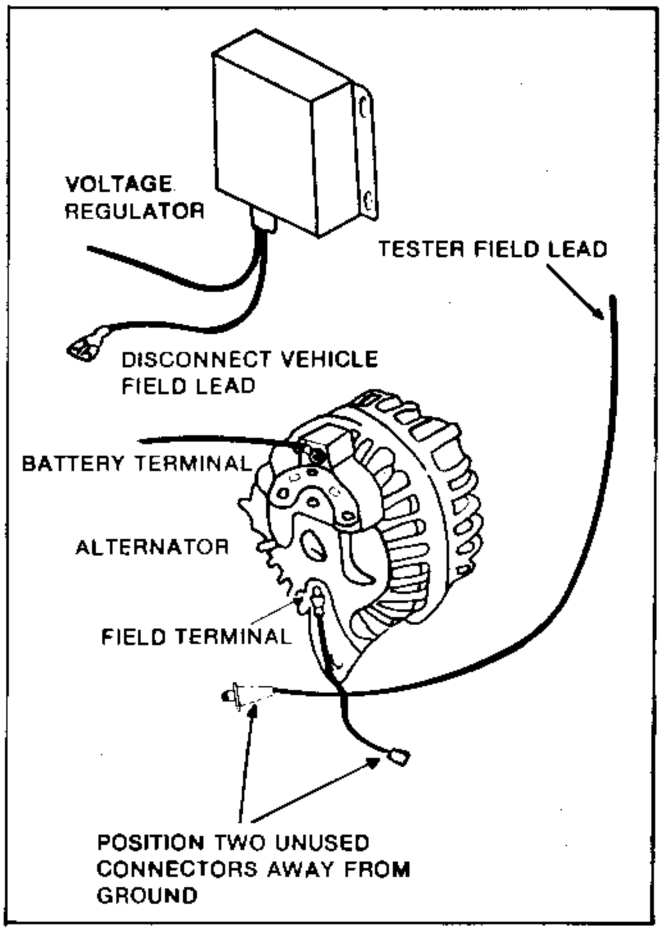

VOLTAGE REGULATOR
TESTER FIELD LEAD
DISCONNECT VEHICLE FIELD LEAD
BATTERY TERMINAL
ALTERNATOR
FIELD TERMINAL
POSITION TWO UNUSED CONNECTORS AWAY FROM GROUND

Figure 3—Field lead connections for testing alternator.

B. Select proper lead terminal and connect the Blue tester field lead to the alternator field terminal (or to the field lead in the regulator connector plug).

CAUTION: Never use Blue field lead with voltage regulator connected.

NOTE: Refer to "Special Alternator Test Information" card Sun #692-855 for identifying field terminal, and for instructions on bypassing regulators on Delcotron alternators with **internal** voltage regulators.

C. Set the TEST SELECTOR to the #2 CHARGING position for systems rated at less than 100 amperes, or to the #1 STARTING position for systems rated over 100 amperes.

D. Start engine and adjust the speed to the manufacturer's specified rpm.

E. Rotate the LOAD INCREASE control clockwise until the voltmeter indicates approximately 2 volts less than system voltage.

F. Hold the spring loaded FIELD SELECTOR in position A or B as indicated on the "Special Alternator Test Information" reference card.

NOTE: Positions reverse on positive ground systems. "A" becomes "B" and "B" becomes "A". However, no damage will occur if the wrong position is used. If it is unknown which system applies ("A" or "B"), test in each position.

G. Adjust the LOAD INCREASE control as required to obtain a reading on the voltmeter as specified by the manufacturer.

H. Observe the reading on the proper ammeter scale.

I. Release the FIELD SELECTOR switch, turn LOAD INCREASE control off and stop engine.

J. Add the ammeter reading observed in Step H to the reading observed in Step C under alternator/generator output Test #2, and compare total to manufacturer's specification.

GOOD—Output falls within 10% of manufacturer's specifications. Check vehicle wiring, replace **voltage regulator** and retest system.

BAD —Output does not fall within manufacturer's specifications. Replace or repair **alternator** per manufacturer's instructions and retest system.

TEST #3 VOLTAGE REGULATOR

A. Set the TEST SELECTOR to the #3 REGULATOR position.

B. Operate engine at approximately 2000 rpm, or at the test speed specified by the manufacturer.

C. Note reading on Green Voltmeter scale afte voltmeter reading ceases to rise, usually when current drops to 10 amps or less. (See manufacturer's specifications.)

GOOD—Voltage reading within manufacturer's specifications.

BAD —Voltage above or below specified voltage range. Replace voltage regulator and retest.

TEST #4 DIODE STATOR

A. Set engine to test speed; and with TEST SELECTOR set in the #3 REGULATOR position, adjust the LOAD INCREASE control if necessary to obtain a charge rate of at least 15 amperes.

NOTE: If at least 15 amps was not obtained in Test 2A, alternator is defective and should be replaced or repaired. Diode test is not valid.

B. Set the TEST SELECTOR to the #4 DIODE STATOR position, and observe the Red and Blue DIODE STATOR scale. Turn load control OFF, return engine speed to idle, and stop engine.

GOOD—Meter reads in Blue area of DIODE STATOR scale.

BAD —Meter reads in Red area of DIODE STATOR scale. Replace or service alternator per manufacturer's instructions and then retest system.

TEST #5 CHARGING SYSTEM REQUIREMENTS

A. With engine stopped and TEST SELECTOR in position #2, turn on all vehicle accessories, ignition switch, headlights at high beam, air conditioning, windshield wipers, rear window defroster if so equipped, etc.

B. Note reading on ammeter. This ammeter reading is the total accessory load. Compare this reading to the total alternator output reading obtained in Test #2, Step G. Total alternator output reading should exceed total accessory load reading by at least 5 amps.

Sun ELECTRIC CORPORATION
3011 EAST ROUTE 176 CRYSTAL LAKE ILLINOIS 60014 815 459 7700
Printed in U.S.A.

NAME ____________________

DATE ____________________

STARTING AND CHARGING SYSTEM TESTING WORKSHEET

Eng. No. ____________________ Make/Year ______________

GOOD BAD

BATTERY PERFORMANCE LOAD TEST

(3X Amp Hour or 1/2 Cold Cranking Current at 0° F)

(voltage remains above 9.6 volts)

Measured ______________ ☐ ☐

STARTING SYSTEM TESTS

(cranking voltage within specifications or above 9.6)

Spec ______________ volts Measured ______________ ☐ ☐

(starter draw within specifications or not more than:
160 amps for 6 cylinder engines
250 amps for V8's except GM
250 amps for GM V8's)

Spec ______________ amps Measured ______________ ☐ ☐

ALTERNATOR-GENERATOR OUTPUT TEST

(alternators – within manufacturer's specifications
generators – within manufacturer's specifications)

Spec ______________ amps Measured ______________ ☐ ☐

If BAD: OUTPUT TEST USING FIELD CONTROL
(alternators within manufacturer's specifications,
generators within manufacturer's specifications)

Spec ______________ amps Measured ______________ amps ☐ ☐

VOLTAGE REGULATOR TEST

(within specifications)

Spec ______________ volts Measured ______________ ☐ ☐

DIODE STATOR TEST

(within Blue area on scale)

Measured Blue area/Red area ☐ ☐

BATTERY DRAIN TEST

(no current flow indicated)

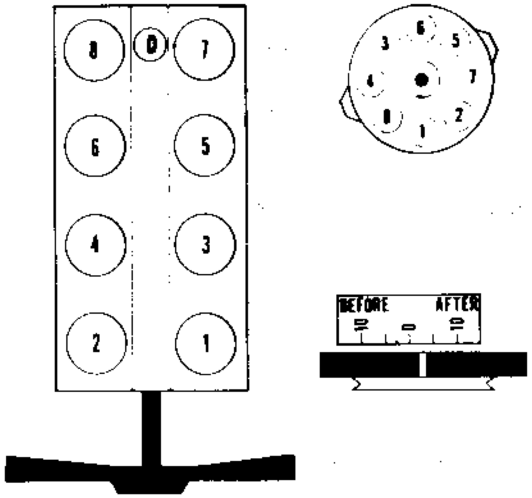
Measured ______________ ☐ ☐

1(75 PLYMOUTH—DODGE

V8-360 CU. IN. W/2 BBL. CARB.

ENGINE
TYPE "LA"

Refer to Card No. 008 for Supplementary Information.



	Engine Code	Tune Up Label
Auto. Trans.		
Federal	K	
Firing Order		1-8-4-3-6-5-7-2
Hydraulic Lifters		Zero Lash
Comp. Ratio		8.4-1
Comp. Pressure		100 psi
Max. allowable difference between highest and lowest cylinders		40 psi

NOTE: Before making compression test or cranking engine with a remote starting switch, turn ignition switch to "ON" position, disconnect coil high tension lead at the distributor cap tower and connect lead to engine ground.

STARTING SYSTEM

BATTERY

12 volt negative ground.

Cranking Voltage (Min.)	9.5V
Cranking Current	180-200A

Application	I.D. Code	AH	Cranking Power Rating at 0° F
Standard		70	440A
W/Air Cond.			
Optional		85	500A

CHARGING SYSTEM
(ELECTRONIC)

Output measured at battery should be within 10% of rated amperage output.

Rated Output color coded tag.

Tag Color	Current Rating	Current Output Minimum
Yellow	34	31A at 15V
Red	41	40A at 15V
Green	50	47A at 15V
Blue or Natural	60	57A at 15V
Black	65	62A at 15V
Yellow	100	72A at 13V
Operating Volage at 80° F		13.9-14.6V

IGNITION SYSTEM
(ELECTRONIC)

SPARK PLUGS	
Champion	N12Y
Gap	.035"
Torque Ft/Lbs. (Gasket required)	30

DISTRIBUTOR	
Chrysler	
	Auto. Trans.
Federal	3874115
Rotation	CW
Dwell	
(Variation)	In response to engine speed
Coil Output	20 KV Min.

IGNITION TIMING

Distributor Vacuum Advance Hose Disconnected & Plugged.

Federal	
Auto. Trans.	6° BTDC at 750 RPM

IGNITION ADVANCE
(Engine Degrees at 2500 RPM)

Direct with a 17 to 27 seconds delay.

	Cent. & Vac.	Cent. Only
Federal		
Auto. Trans.	35-45	15-20

FUEL SYSTEM
(HOLLEY 2245)

CARBURETOR

	Auto. Trans.
Federal	R7226A

Idle Controls

Throttle Position Solenoid

When the electronic speed switch senses 2000 RPM the solenoid is energized and the solenoid provides a throttle stop to maintain a steady rate of 1500 RPM engine speed on de-acceleration. When the engine speed drops below 2000 RPM the solenoid is de-energized and the throttle allowed to return to the normal idle stop position.

Idle Speed [RPM]
(AC-OFF)

	Carb. Screw Idle
Federal	
Auto. Trans.	750N

[Cold] Fast Idle Speed

Adjusting screw against second highest step of cam, disconnect and plug distributor vacuum advance hose. Disconnect and plug EGR valve vacuum hose.

Federal	
Auto Trans.	1600N

IDLE MIXTURE

Set idle speed and CO with air pump disconnected, if so equipped.

Emission Level	**HC [ppm CO [%]** Ahead of Catalyst
Federal	
Auto. Trans.	.3 at 750N-RPM

Accel. Pump Enrichment	**CO level increase At 2500 RPM**
Federal	

FUEL PUMP

Disconnect fuel return line and plug the pump port opening, if so equipped.

Pressure (At Idle)	5-7 psi
Volume (At Idle)	1 PT-30 Seconds
Vacuum (At Idle)	10" Min.

SUN ELECTRIC CORPORATION 1975
HARLEM & AVONDALE CHICAGO, ILLINOIS 60631

19 PLYMOUTH—DODGE

V8-360 CU. IN. W/2 BBL. CARB.

AIR CONDITIONING SPECIFICATIONS

BELT TENSION

New	100 Ft/Lbs.
Used	70 Ft/Lbs.

PRESSURES
(At 1750 RPM 80° F)

Compressor Discharge Side	140-210 psi
Evaporator Suction Side	22-29 psi
Compressor Suction Side	15 or less psi

REFRIGERANT CAPACITY

Car Line

R W S X	4.12 lbs. R-12
P D C Y	4.25 lbs. R-12

FUEL SYSTEM

Fuel Filter—In line
Replace at 15,000 mile intervals.

Electric assist choke system—Provides rapid choke opening at ambient temperatures of 68° F or above and a slower choke opening at temperatures of 58° F or below. The shutdown will result after the control switch warms to about 130° F by engine heat.

CCIE—Carburetor Idle Fuel Enrichment Circuit

AIR CLEANER

With engine compartment less than 90° F. heat control door in snorkel should be in UP or heat on position. When air temperature entering snorkel is 110° F or higher, door should be DOWN or in heat off position. With minimum of 5" vacuum applied at vacuum diaphragm, control valve door should begin to move upward. With a maximum of 9" vacuum applied, door should move to closed position.

IGNITION SYSTEM
ELECTRONIC

DISTRIBUTOR
Chrysler

	Auto. Trans.
Federal	3874115
Rotation	CW

TIMING ADVANCE CONTROL CIRCUIT

Direct with a 17 to 27 seconds OSAC valve delay in vacuum spark advance and the 2000 RPM electronic speed switch.

OSAC—Test with engine at 2000 RPM by connecting a vacuum gauge to distributor side of OSAC valve. Vacuum should take about 15 seconds to stabilize. If vacuum "pops" to manifold vacuum or no vacuum increase occurs, and hoses are in good condition, OSAC valve should be replaced.

MECHANICAL ADVANCE **VACUUM ADVANCE**
Dist. No. 3874115

Dist. RPM	Dist. Deg.	In. Vac.	Dist. Deg.
500	1-3½	7	½-2½
900	6-8½	12½	10-12
2000	10-12		

Air Gap—Pickup coil tooth/reluctor tooth	.008" nonmagnetic gauge .010" no-go
Pickup coil resistance	400-600 ohms at 70° F-80° F

IGNITION COIL

	Chrysler-Prestolite 2444242	Chrysler-Essex 2444241
Pri. Resistance	1.60-1.79 ohms	1.41-1.62 ohms
Sec. Resistance	9400-11,700 ohms	8000-11,200 ohms

Ballast Resistor

Compensating (Coil Side)	.5-.6 ohms at 70° F-80° F
Auxiliary (Control Unit Side)	4.75-5.75 ohms at 70° F-80° F

IGNITION CURRENT

Engine Stopped	3.0 Amps
Engine Cranking	
Engine Idling	

HI TENSION WIRE RESISTANCE

Coil Cable Intact (Either primary terminal of coil to center contact of dist. cap)	25,000 Ohms Max.
Coil Cable Removed	15,000 Ohms Max.
Spark Plug Cables	
(To 25" length)	30,000 Ohms Max.
(Over 25" length)	50,000 Ohms Max.

EMISSION CONTROLS & TESTING

Federal

CC	Catalytic Converter
CCIE	Coolant Control Idle Enrichment
ECS	Evaporative Control System
EGR	Exhaust Gas Recirculation
EGR/CC	Coolant Temperature Control Valve
EGR/VA	Vacuum Amplifier
EGR/TD	Time Delay Valve
ESC	Electronic Speed Switch
OSAC	Orifice Spark Advance Control
PCV	Positive Crankcase Ventilation
TIC	Ignition/Coolant Temperature Override Valve

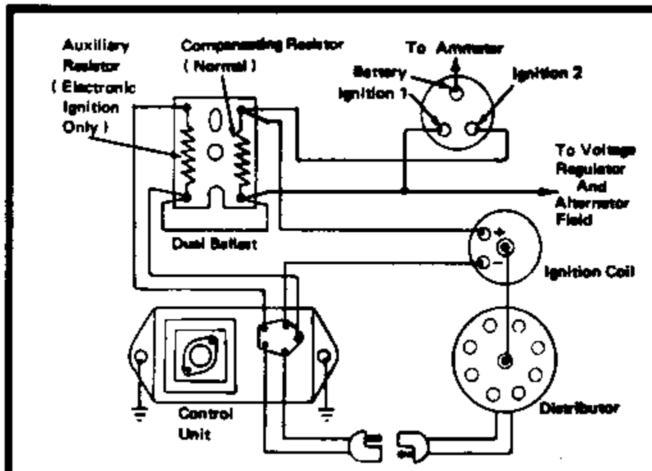
Refer to 008A for further detailed information.

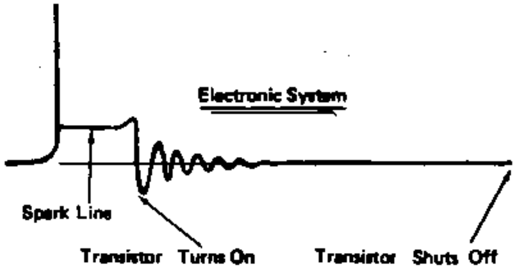
FORM NO. 690-750-013
LITHO IN U.S.A.

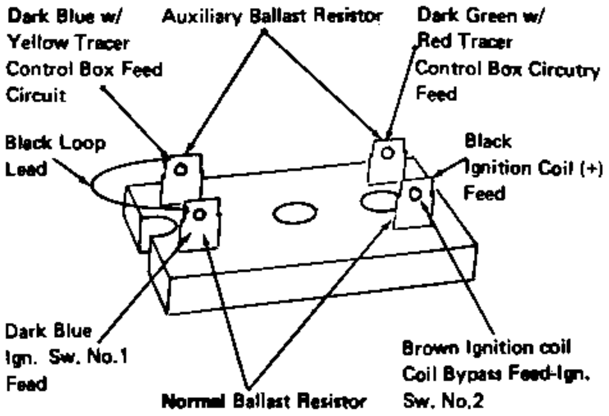
SUN ELECTRIC CORPORATION 1975
HARLEM & AVONDALE CHICAGO, ILLINOIS 60631

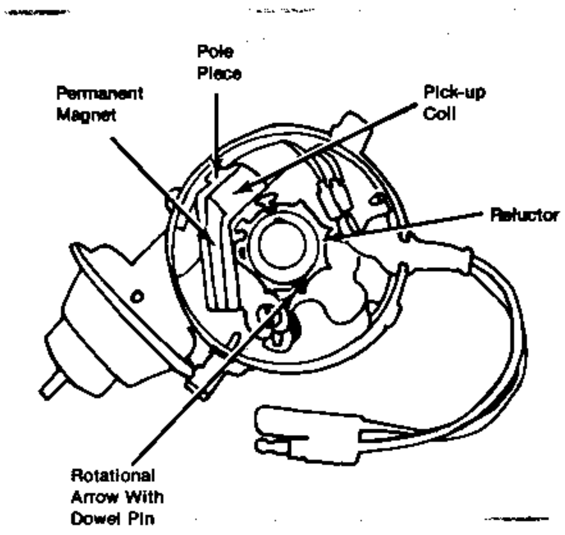
008 1975 CHRYSLER CORP. SUPPLEMENTARY INFORMATION

(See reverse side for Starting & Charging System Tests.)


Auxiliary Resistor (Electronic Ignition Only)
Compensating Resistor (Normal)
To Ammeter
Battery Ignition 1
Ignition 2
To Voltage Regulator And Alternator Field
Dual Ballast
Ignition Coil
Control Unit
Distributor




Dark Blue w/ Yellow Tracer Control Box Feed Circuit
Auxiliary Ballast Resistor
Dark Green w/ Red Tracer Control Box Circutry Feed
Black Loop Lead
Black Ignition Coil (+) Feed
Dark Blue Ign. Sw. No.1 Feed
Normal Ballast Resistor
Brown Ignition coil Coil Bypass Feed-Ign. Sw. No.2



ELECTRONIC IGNITION

Measure voltages and study system wave patterns with a Sun Engine Tester just like conventional ignition systems. Scope connections to electronic system are identical to conventional systems.

AIR GAP ADJUSTMENT

Loosen pickup hold down screw and align one reluctor blade with pickup pole. Insert a non-magnetic .008" feeler gauge between blade and pickup and move pickup until contact is made between pickup, feeler gauge and blade. Tighten pickup hold down screw. Check gap for a no-go fit with a .010" feeler gauge. DO NOT force feeler gauge into gap. Apply vacuum to vacuum unit and rotate governor shaft. Pickup pole should not contact reluctor teeth. Readjust gap if contact is made and check for a bent shaft if contact occurs on only one side of reluctor.

TROUBLE SHOOTING

Engine Will Not Start, Fuel & Carburetion OK—

1) Check resistance of each section of Dual Ballast. Compensating resistance should be .5-.6 ohms at 70-80° F. Auxiliary Ballast resistance should be 4.75-5.75 ohms. Replace if faulty. Check wire positions.

2) Check for carbonized coil tower. Check primary and secondary resistances: Primary—1.41-1.79 ohms at 70°; Secondary—9200-11,700 ohms at 70-80° F. Check coil in tester.

3) Faulty pickup coil or improper pickup coil air gap. Check pickup coil resistance, it should be 400-800 ohms.

4) Inspect wiring for brittle insulation. Inspect connectors. Molded connectors should be inspected for rubber inside female terminals.

5) Replace control unit if all above checks are negative. Whenever control unit or dual ballast are replaced, make sure dual ballast wires are correctly inserted in the keyed molded connector.

Severe Engine Surge Not Caused by Lean Carburetion—

1) Inspect for loose connector and/or broken conductors in harness. Disconnect vacuum advance. If surging stops, replace pickup.

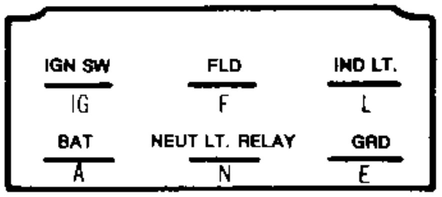
Engine Misses And Carburetion is Good—

1) Check secondary cables with an ohmmeter, or observe secondary circuit performance with oscilloscope.

2) Check ignition coil for carbonized tower. Check wiring for loose or dirty connections.

3) Replace control unit if above checks are negative.

COLT-REGULATOR COUPLER



FRONT OF COUPLER

SERVICE CONTROL SYSTEM

COLOR	ALTERNATOR MODEL & STAMPED NO.	RATED OUTPUT	REGULATOR MODEL	ROTATION AT DRIVE END	COLD OUTPUT WHEN MEASURED AT BATTERY Add 5 Amps. for Total Output	ENGINE RPM	FIELD CURRENT AT 12V ROTATING ROTOR BY HAND	BELT TENSION GAUGE LBS.			
								New		Used	
								WO/AC	W/AC	WO/AC	W/AC
Yellow	Chrya. Corp. 3755403	34 Amp	Electronic 12V Neg. Grd. 3438150-3755960	Clockwise	29-31 amps At 15 Volta	1250	2.5-3.7 amps	225 Cu. In. 15	15	10	10
Red	Chrys. Corp. 3755404	41 Amp	Electronic 12V Neg. Grd. 3438150-3755960	Clockwise	35-36 amps At 15 Volts	1250	2.5-3.7 amps	318 Cu. In. 35	100	25	70
Green	Chrys. Corp. 3755406 3755411	50 Amp	Electronic 12V Neg. Grd. 3438150-3755960	Clockwise	42-45 amps At 15 Volts	1250	2.5-3.7 amps	360 Cu. In. 35	100	25	70
Blue or Natural	Chrys. Corp. 3755413	60 Amp	Electronic 12V Neg. Grd. 3438150-3755960	Clockwise	52-55 amps At 15 Volta	1250	2.5-3.7 ampa	400 Cu. In. 70	120	40	60
Yellow	Chrys. Corp. 3755585	100 Amp	Electronic 12V Neg. Grd. 3755850	Clockwise	70-72 amps At 13 Volts	900	4.75-6.0 amps	440 Cu. In. Except Imp. 70 440 Cu. In. Imperial 70	120 45	40 40	80 30
	Mitaubishi AH2040K1	40 Amp	RQB2220D1	Clockwise	35 amps At 14 Volts	2500		Tension Force 22/Lbs. Belt Deflection .028-.035 In.			

STARTING SYSTEM SPECIFICATIONS & TESTS

STARTER DRAW

Cranking (Engine Warm)	
225" & 318"	165-180 amps.
360", 400" & 440"	180-200 amps.
Free Running (At 3700-4200 RPM)	90 amps. at 11 Volts

SOLENOID DRAW AT 77° F.

Pull-in Coil	13-15 amps. at 6 Volts
Hold-In Coil	8-9 amps at 6 Volts

CRANKING CIRCUIT RESISTANCE

Use tenths of a volt-meter scale and take readings while engine is cranked. Readings not to exceed specifications.

Insulated Circuit

Bat. Pos. Post to Sol. Bat. Term.	.2V
Each Connection	.0V

Ground Circuit

Starter Housing to Bat. Neg. Post	.2V
Ground Cable Only	.2V
Each Connection	.0V

CHARGING SYSTEM SPECIFICATIONS & TESTS

Connect a charging system tester. Adjust to obtain maximum current output. If output is within 10% of rated output alternator is good.

REGULATOR-Electronic
12 Volta Neg. Grd. Chrysler-3438150-3755960-3755850

CHARGING CIRCUIT RESISTANCE
Connect DC voltmeter positive lead to alternator battery terminal. Neg. lead to battery end of pos. battery cable. With 20 amp. load meter indication should not exceed .7 volt.

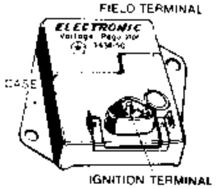
OPERATING VOLTAGE REGULATION
Voltmeter connected pos. lead to battery pos. post. Neg. lead to a good vehicle body ground.

OPERATING VOLTAGE TEST
Related to temperature and fully charged battery. Operate engine at 1250 RPM with all lights and accessories off.
Temperature measured with thermometer ¼" above regulator.

TEMP. (degrees)	—20	60	140	Above 140
VOLTS min.	14.9	13.9	13.3	Less than
VOLTS max.	15.9	14.6	13.9	13.6

Below Specification Limits
If operating voltage is below specification limits check for voltage drop between voltage regulator case and body and between body and engine.

Above Specification Limits
If operating voltage fluctuates or is slightly above specifications check for voltage drop between voltage regulator case and body and between body and engine.
NOTE: If operating voltage is more than .5 Volt above specification limits replace regulator.



FIELD RELAY
B and C body vehicles have an ignition switch controlled field relay.

FIELD CIRCUIT TEST—Turn off ignition switch and disconnect voltage regulator connector plug.
With ignition Switch in the **ON** position battery voltage should be indicated at the connector plug-Blue lead (ignition terminal) and green lead (field terminal).

FORM NO: 690-750-008
LITHO IN U.S.A.

HARLEM & AVONDALE CHICAGO, ILLINOIS 60631

Sun SERVICE CONTROL SYSTEM

1975 CHRYSLER CORP. SUPPLEMENTARY INFORMATION

A SUPPLEMENT TO CARD 011-012-013-014-015-016-017

		Federal	Calif.
AIR	Air Injection Reactor	X	X
CC	Catalytic Converter	X	X
CCIE	Coolant Control Idle Enrichment	X	X
ECS	Evaporative Control System	X	X
EGR	Exhaust Gas Recirculation	X	X
EGR/CC	Coolant Temperature Control Valve	X	X
EGR/VA	Vacuum Amplifier	X	X
EGR/TD	Time Delay Valve	X	X
ESC	Electronic Speed Switch	X	X
OSAC	Orifice Spark Advance Control	X	X
PCV	Positive Crankcase Ventilation	X	X
TIC	Ignition/Coolent Temperature Override Valve	X	X

CCIE—IDLE ENRICHMENT—The purpose of the enrichment ia to reduce cold engine stalling. A small vacuum controlled diaphragm mounted near the top of carburetor controls idle system air. When control vacuum is applied to the diaphragm, idle system air is reduced. Air losses strengthen the small vacuum signal within the idle system and fuel flow increases. Operation of enrichment is via a block coolant valve with block coolant temperatures below (150° F, Federal) (98° F Calif.).

EGR/CC—COOLANT TEMPERATURE CONTROL VALVE—The coolant temperature valve is located in the radiator upper tank. With coolant temperatures below 65° F, the valve remains closed not allowing the EGR system to function. With temperatures above 65° F, the valve opens allowing the EGR system to function.

EGR/VA—VACUUM AMPLIFIER—Control of the EGR system rate is accomplished by a carburetor venturi or ported vacuum signal. Because of the low amplitude of this signal, it is necessary to use an emplifier to utilize a portion of the engine manifold vacuum to function the EGR system.

EGR/TD—TIME DELAY VALVE—The system consists of an electronic timer and a three way vacuum solenoid valve. The timer energizes the solenoid during starting and for 35 seconds after, at which time the solenoid is again de-energized. When the solenoid valve is energized it has two functions. First, it cuts off the manifold vacuum source to the EGR amplifier and the EGR system is not allowed to function. Secondly, it applies manifold vacuum to the idle enrichment system which initiates idle enrichment. Thirty five seconds after the engine starts, the timer de-energizes the solenoid, the EGR system is allowed to function, and the idle enrichment system cuts off.

ESC—ELECTRONIC SPEED SWITCH—The switch senses engine RPM and controls the de-acceleration RPM's to adequately dilute the gas flow and protect the converter from overheating.

OSAC—ORIFICED SPARK CONTROL—A tiny orifice incorporated in the OSAC valve delays the ported vacuum change to the distributor by about 17 to 27 seconds when going from idle to part throttle. When going from part throttle to idle, the change in ported vacuum to the distributor will be instantaneous.

TIC—TEMPERATURE OVERRIDE VALVE—The thermal ignition valve is used on some engines equipped with maximum cooling and/or air conditioning to reduce the possibility of engine overheating under adverse operating conditions. When engine coolant temperature at idle reaches 225° F, the valve allows manifold vacuum to be applied to the distributor vacuum advance to increase the engine idle speed and provide additional engine cooling.

EGR/RPM —DROP TEST—Record carburetor EGR port vacuum signal at 3000 RPM snap throttle. Apply an external recorded vacuum signal to the disconnected carburetor port signal hose. Engine speed should drop 150 RPM or more.

NAME ______________________

DATE ______________________

SPECIFICATION CARD WORKSHEET

Use 1975 Specification and Supplementary Cards

1. Year ______________________
2. Car Make ______________________
3. Number of Cylinders ______________
4. Displacement ________________
5. Carburetor ______________________
6. Transmission type Automatic
7. w/wo Anti Pollution Equip. with
8. w/wo Air Conditioning with
9. Spec. Card Number ______________
10. Supplementary Card Number ________

11. COMPRESSION PRESSURE (Engine Section) — Spec. __________ PSI

12. COMPRESSION VARIATION (Engine Section) — Spec. __________ PSI Max. Var.

13. DISTRIBUTOR ROTATION (Engine Section) — Spec. __________ Rotation

14. AIR GAP ADJUSTMENT (Supplementary Information) — Spec. __________ Inch

15. PICKUP COIL RESISTANCE Troubleshooting (# 3) — Spec. __________ to __________ Ohms

16. CRANKING VOLTAGE (Starting Section) — Spec. __________ Volts (Min.)

17. OPERATING VOLTAGE (Charging Section) — Spec. ______ to ______ Volts @ ______ ° F

18. COIL OUTPUT (Ignition Section) — Spec. __________ KV (Min.)

19. IGNITION TIMING (Federal) — Spec. ______ ° ______ TDC @ ______ RPM

20. IGNITION ADVANCE ° @ 2500 RPM (Ignition Section)
Spec. ______ ° to ______ °
Spec. ______ ° to ______ ° Cent. Only

SPECIFICATION CARD WORKSHEET (con't.)

21. IDLE SPEED Spec. __________ RPM (Fed.)
(Fuel Section)

22. EMISSION LEVELS Spec. ________ @ __________ RPM (Fed.)
(Fuel Section)

23. FUEL PUMP PRESSURE Spec. ________ to __________ PSI @ _____ RPM
(Fuel Section)

24. FUEL PUMP VOLUME Spec. ________ PT @ __________ Sec. @ _____ RPM
(Fuel Section)

25. COMPRESSOR DISCHARGE SIDE Spec. ________ to __________ PSI
(A/C Section)

26. REPLACE FUEL FILTER Spec. __________ Mile Intervals
(Fuel System)

27. PRIMARY RESISTANCE (PRESTOLITE) Spec. ________ to __________ Ohms
(Ignition Coil Section)

28. IGNITION CURRENT Spec. __________ Amps
(Ignition Section)

29. EGR MEANS __________ __________ __________
(Emission Control Section)

30. OSAC TIME DELAY __________ to __________ Seconds
(Supplementary Card)

31. TIC ACTIVATION TEMPERATURE __________ ° F
(Supplementary Card)

1975 CHEVROLET SUPPLEMENTARY INFORMATION

(See reverse side for Starting & Charging Systems Tests.)

PREPARATION FOR TESTS — INFF 'ED TESTING
EXHAUST EMISSION — IDLE MIXT(. PROCEDURE
ELECTRONIC IGNITION TESTING

IDLE MIXTURE ADJUSTMENT

1. Engine at normal operating temperature w/air conditioning off, air cleaner removed.
2. Plug air cleaner engine vacuum supply port.
3. Set parking brake, block drive wheels.
4. Cut off mixture screw(s) cap(s) stop tab(s).

TACHOMETER [SPEED DROP] PROCEDURE —

Place automatic transmission in "D", manual transmission in "N" and using idle speed screw or solenoid plunger (solenoid energized, if so equipped) adjust speed to higher RPM specified. Adjust mixture screw(s) equally until maximum RPM is obtained. If required, reset idle speed to higher RPM specified. Turn mixture screw(s) in (lean) to obtain lower RPM specified. Install air cleaner and air cleaner vacuum hose and recheck idle speed. Use mixture screw(s) for idle RPM correction if required.

To check speeds after adjustment, move transmission to "N" and operate engine at 2000 RPM for 5 to 10 seconds.

Final setting of RPM should be checked with air cleaner installed.

IDLE MIXTURE LEAN DROP IDLE SPEEDS

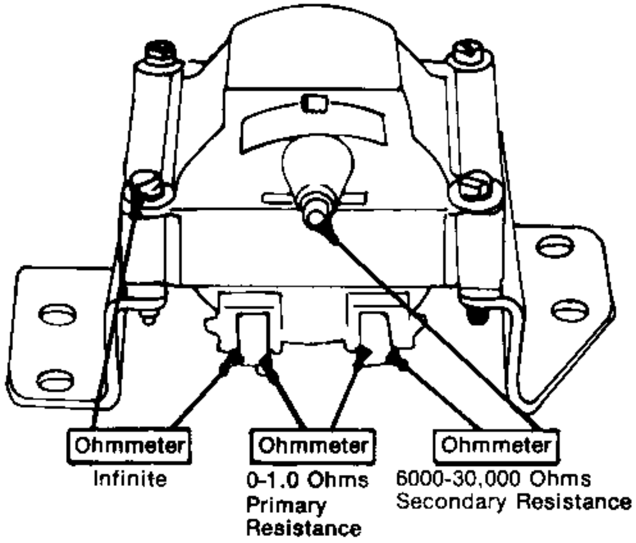
Applications	Man. Trans.	Auto. Trans.
140" W/1 Bbl.	825/700 N	850/750 DR
140" W/2 Bbl.	820/700 N	830/750 DR
250" W/Integrated Manifold		
Federal	1200/850 N	580/550 DR
Calif.		640/600 DR
250" W/Non Integrated Manifold		
Federal		640/600 DR
262" Federal	900/800 N	630/600 DR
350" W/2 Bbl. Federal	900/800 N	650/600 DR
350" W/4 Bbl. Hi Perf		
Federal	1000/900 N	750/700 DR
350"-400" W/4 Bbl.		
Federal	900/800 N	650/600 DR
Calif.		650/600 DR
454" W/4 Bbl.		
Federal		630/600 DR

ELECTRONIC IGNITION

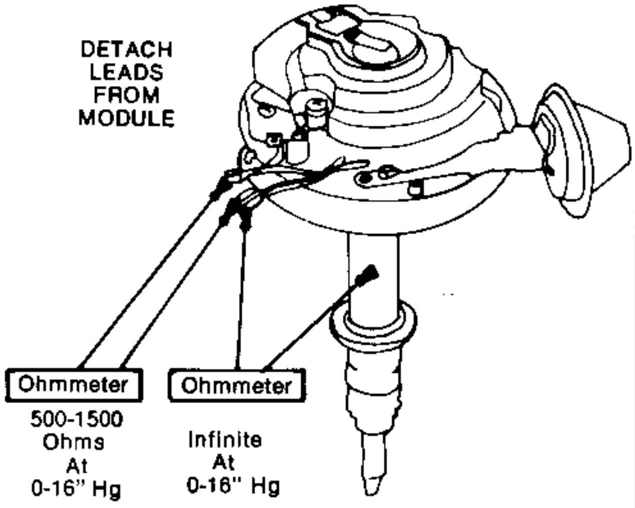
CAUTION — Do not ground "Tach" terminal on distributor connector plug.

Connect voltmeter between "BAT" terminal lead on distributor connector and ground. Turn on ignition switch. If voltage reads zero, system has an open circuit.

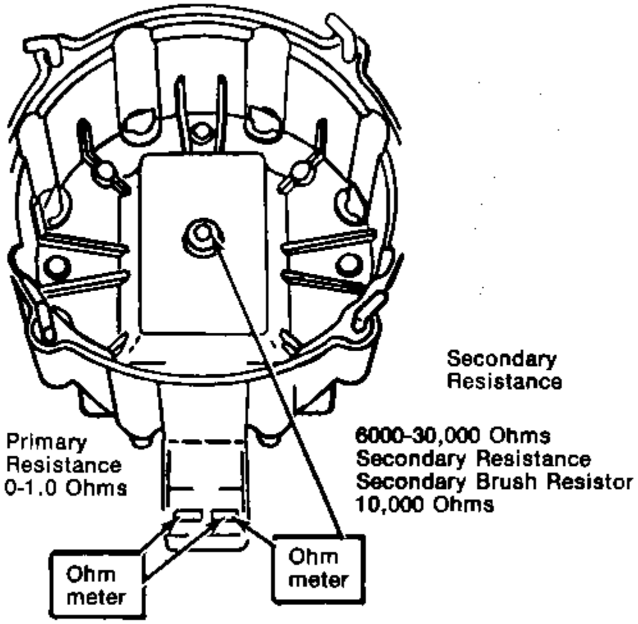
BENCH TESTING
L4 CYL-L6 CYL IGNITION COIL



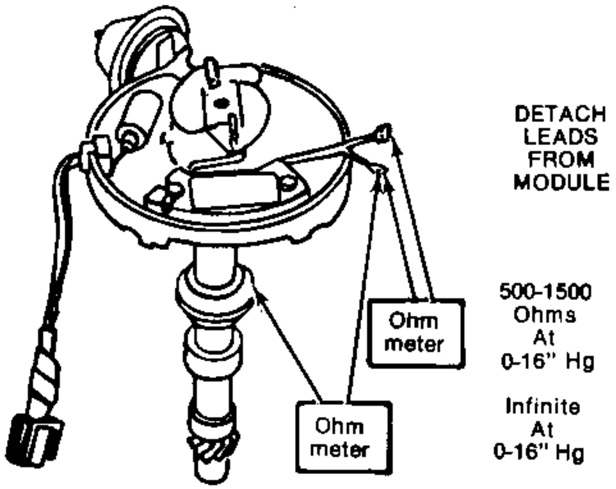
4 CYL-6 CYL - PICKUP COIL



V8 IGNITION COIL



V8 PICKUP COIL



With vacuum tester connected to vacuum advance.

ALTERNATOR MODEL & STAMPED NO.	RATED OUTPUT	REGULATOR MODEL	ROTATION At DRIVE END	COLD OUTPUT WHEN MEASURED AT BATTERY Add 5 Amps. for Total Output	ENGINE RPM	GEN RPM	BENCH TESTING FIELD CURRENT At 80°F	BELT TENSION GAUGE LBS. ± 5 New	Used
1100545(Vega Only) 1100559(Vega Only)	32 Amp.	Integral Non Adjustable	Clockwise	31 Amps. At 80°F		5000	4-4.5 Amps. At 12 Volts	125	75
1100497-1102394 1102397-1102483 1102491-1102492 1102856-1102856	37 Amp.	Integral Non Adjustable	Clockwise	33 Amps. At 80°F		5000	4-4.5 Amps. At 12 Volts	125	75
1100950- 1102481-1102463	42 Amp.	Integral Non Adjustable	Clockwise	37 Amps. At 80°F		5000	4-4.5 Amps. At 12 Volts	125	75
1100546-1100560 1100575-1102476 1102478-1102479 1102500-1102851 1102869-	55 Amps.	Integral Non Adjustable	Clockwise	50 Amps. At 80°F		5000	4-4.5 Amps. At 12 Volts	125	75
1100544-1100597 1102347-1102474 1102480-1102486	61 Amp.	Integral Non Adjustable	Clockwise	55 Amps. At 80°F		5000	4-4.5 Amps. At 12 Volts	125	75
1102854- 1102857-	63 Amp.	Integral Non Adjustable	Clockwise	60 Amps. At 80°F		5000	4-4.5 Amps. At 12 Volts	125	75

STARTING SYSTEMS

STARTER DRAW

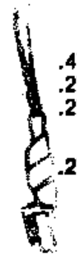
Free running current draw including solenoid.

4 Cyl.	50-75 amps. at 9 Volts at 6500-10,000 RPM
6 Cyl.	50-80 amps. at 9 Volts at 5500-10,500 RPM
V8	65-95 amps. at 9 Volts at 7500-10,500 RPM
V8 262 Cu. In.	55-80 amps. at 9 Volts at 3500-6,000 RPM

SOLENOID CURRENT DRAW

Hold-In Windings	14.5-16.5 amps. at 10V
Both Windings	41-47 amps. at 10V

CRANKING CIRCUIT RESISTANCE



Insulated Circuit

Bat. Pos. Post to Starter Term. of Solenoid	.4V
Pos. Bat. Cable Only	.2V
Solenoid Only	.2V

Ground Circuit

Bat. Neg. Post to Starter Housing	.2V

CHARGING SYSTEM SPECIFICATIONS & TESTS

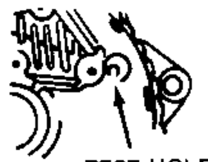
CHARGING CIRCUIT RESISTANCE TEST

Operate engine at 1000 RPM with 10 Amp. load.

With Ind. Light	0.3V
With Ammeter	0.7V
Ground Circuit	.05V

CURRENT OUTPUT TEST

Connect a charging system tester. Adjust load control to obtain maximum current output. If output is within 10% of rated output, alternator is good. If not, connect tester field lead to a probe. Insert probe into test hole and contact tab. Caution—Tab is within ¾" of casting surface. Do not force probe deeper than 1" into end frame. Operate engine at moderate speed. With field switch in "A" position, adjust load control to obtain maximum current output. If output is within 10% of rated output, regulator is defective. If not, test alternator components.



OPERATING VOLTAGE [REGULATOR] TEST

Related to temperature and fully charged battery. Voltmeter pos. lead connected to positive battery terminal and neg. lead connected to ground. Operate engine for 15 minutes at 1500 RPM. Load system with 5 amps. or less. Voltage should be within specifications 13.8 to 14.8 Volts at 80° F.

FORM NO: 690-750-038
LITHO IN U.S.A.

© SUN ELECTRIC CORPORATION 1975
HARLEM & AVONDALE CHICAGO, ILLINOIS 60631

Sun SERVICE CONTROL SYSTEM

039

1975 CHEVROLET—VEGA

L4-4 CYL. 140 CU. IN. W/1 BBL. CARB.

AIR CONDITIONING SPECIFICATIONS
ENGINE COMPONENT APPLICAT & TESTING
EMISSION CONTROL COMPONENT TESTING

AIR CONDITIONING SPECIFICATIONS
FOUR SEASONS

BELT TENSION

New	135-145 Ft/Lbs.
Used	90-100 Ft/Lbs.

PRESSURES
(At 1500 RPM 80° F)

Discharge (High Side)	185-235 psi
Suction (Low Side)	29½-34½ psi

NOTE: Allow .5 psi (Suction) increase per 1000 feet above sea level.

REFRIGERANT CAPACITY

All Models	2.81 Lbs.-R12

FUEL SYSTEM

Fuel Filter—Behind carburetor inlet nut.
Replace at 15,000 mile or 12 month intervals.

Auxiliary Secondary Diaphragm—Located on carburetor.

When vehicle is started (Cold engine)—
When coolant temperature reaches 93° F the choke valve is pulled open, even though screw is on high step of cam.

When vehicle is started (Warm engine)—
When coolant temperature is abova 93° F choke valve should be open and not move.

THERMAL AIR CLEANER

Disposable type air cleaner unit.
Not serviceable—replace every 50,000 miles or as required.

Engine off and underhood temperature below 85° F., Snorkel Passage should be open—Heat off position. Engine at idle and underhood temperature below 85° F., Snorkel Passage should be closed—Heat on position. With underhood temperature 85-125° F., Snorkel Passage control damper door should begin to open (Heat Off). Underhood temperature above 128° F., Snorkel Passage should be open—Heat Off position. With a minimum of 9" vacuum applied to diaphragm assembly, damper door should completely close Snorkel Passage.

IGNITION SYSTEM
HEI-HIGH ENERGY IGNITION

DISTRIBUTOR
Delco

	Man. Trans.	Auto. Trans.
Federal	1112862	1112862
Rotation	CW	CW
Dwell		

TIMING ADVANCE CONTROL CIRCUIT

Manual Trans.—Transmission controlled spark advance.
Auto. Trans.—Direct

Transmission Controlled Spark Advance—Connect tester vacuum gauge (using "T" fitting) at distributor vacuum advance unit. Jack-up rear wheels and place transmission in drive range. Accelerate engine until transmission shifts into high gear or to specified miles per hour reading. Tester vacuum gauge should now indicate specified distributor advance vacuum.

MECHANICAL ADVANCE — VACUUM ADVANCE
Dist. No. 1112862

Dist. RPM	Dist. Deg.	In. Vac.	Dist. Deg.
810	0	5	0
1000	2½	12	12
2400	11		

Pulse coil resistance	500-1500 ohms

IGNITION COIL

Pri. Resistance	0-1.0 ohms
Sec. Resistance	6,000-30,000 ohms
Ballast Resistor	None

IGNITION CURRENT

Engine Stopped	.1-.2 amps
Engine Cranking	.5-1.5 amps
Engine Idling	.5-1.5 amps
2000-2500 RPM	1.0-2.8 amps

HI TENSION WIRE RESISTANCE

Wire Length	Min.	Max.
0-15"	3000	10,000 ohms
15-25"	4000	15,000 ohms
25-35"	6000	20,000 ohms
Over 35"	—	25,000 ohms

EMISSION CONTROLS & TESTING

Federal

CHA/TAC	Thermal Controlled Carburetor Hot Air
EGR	Exhaust Gas Recirculation
ECS	Evaporation Control System
PCV	Positive Crankcase Ventilation
UFC	Under Floor Catalytic Converter

EGR/RPM DROP TEST—Record carburetor EGR port vacuum signal at 3000 RPM snap throttle. Apply an external recorded vacuum signal to the disconnected carburetor port signal hose. Engine speed should drop 150 RPM or more.

HARLEM AVONDALE CHICAGO ILLINOIS 60631

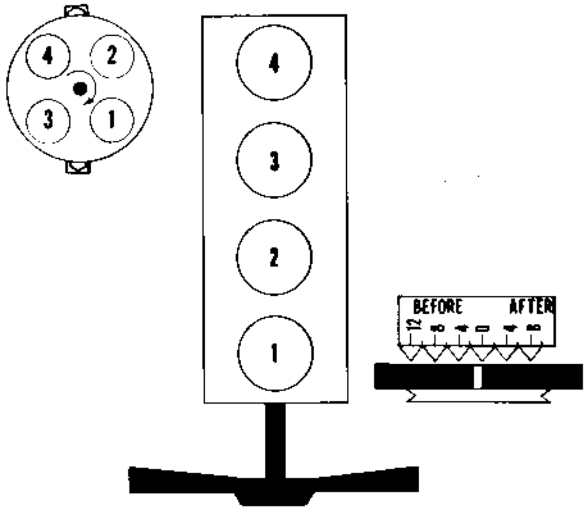
SERVICE CONTROL SYSTEM

1975 CHEVROLET—VEGA

L4-4CYL 140 CU. IN. W/1 BBL. CARB. [FEDERAL ONLY]

ENGINE

Refer to Card No. 038 for Supplementary Information.



Timing Belt Tension		100-140 Ft/Lbs.
	Engine Code Federal	**Tune-Up Label Federal**
Man. Trans.	B	10C11
Auto. Trans.	B	10C11

Firing Order	1-3-4-2
Mechanical Lifters (Engine off)	
Inlet (COLD)	.014"-.017"
Exhaust (COLD)	.029"-.032"
Comp. Ratio	8.0-1
Comp. Pressure	140 psi
Max. allowable difference between highest and lowest cylinders	20 psi

NOTE: When making compression test or cranking engine with a remote starting switch, turn ignition switch to the "ON" position. Disconnect the coil hi tension lead at the distributor cap coil tower and connect lead to engine ground.

STARTING SYSTEM

BATTERY

12 volt negative ground.
Cranking Voltage (Min.) 9.0V

Application	**I.D. Code**	**AH**	**Cranking Power Watts at 0°F**
Standard W/Air Cond.	Y87P	45	275A-2500W
Optional	R87P	55	335-3200

CHARGING SYSTEM
DELCOTRON-10SI

Output measured at battery should be within 10% of rated amperage output.

Rated output stamped on generator frame.

Application	**Rated Amp. Output**
Standard	32A
W/Air Cond.	55A
Optional W/Rear window defroster	55A
Heavy Duty	63A
Operating Voltage at 125° F	13.4-14.4V

IGNITION SYSTEM
HEI-HIGH ENERGY IGNITION

SPARK PLUGS

AC	R43TSX
Gap	.060"
Torque Ft. Lbs.	15

DISTRIBUTOR

Delco

	Man. Trans.	**Auto. Trans.**
Federal	1112862	1112862
Rotation	CW	CW

Dwell	Not adjustable
(Variation) In response to engine speed.	
Coil Output	20 KV Min.

IGNITION TIMING

Distributor vacuum advance hose disconnected and plugged.

Federal	
Man. Trans.	8° BTDC at 700 RPM
Auto. Trans.	10° BTDC at 750 RPM

IGNITION ADVANCE
(Engine Degrees at 2500 RPM)

Manual trans.—Connect a manifold vacuum source to dist. vac. adv.
Auto. trans.—Direct

	Cent. & Vac.	**Cent. Only.**
Federal		
Man. Trans.	31-35	7-9
Auto. Trans.	31-35	7-9

FUEL SYSTEM
ROCHESTER IMV MONOJET

CARBURETOR

	Man. Trans.		**Auto. Trans.**
Federal	7045025		7045024
W/AC	7045029	W/AC	7045028

Idle Controls

Idle Stop Solenoid

Engine at normal operating temperature.
Set parking brake—block wheels.
Disconnect fuel tank hose at vapor canister.
Adjust solenoid to specifications-energized.
Disconnect solenoid wire connector.
Adjust solenoid 1/8" hex screw to specifications-de-energized.
Reconnect solenoid wire connector and fuel tank hose.

Idle Speed [RPM]
(AC-Off)

	Solenoid Energized	**Carb. Screw Idle Solenoid De-energized**
Federal		
Man. Trans.	1200N	700N
Auto. Trans.	750DR	550DR

[Cold] Fast Idle Speed
(AC-Off)

Adjusting screw against high step of cam.

Federal	
Man. Trans.	2000N
Auto. Trans.	2200N

IDLE MIXTURE

Emission Level	**HC [ppm]**	**CO [%]**
Federal		
Man. Trans.		
Auto. Trans.		

Accel. Pump Enrichment	**CO level increase At 2500 RPM**
Federal	

FUEL PUMP

Electric—The electric feed circuit involves the cranking circuit oil pressure switch and the warning lamp. Two fuses for fuel pump operation/gauge radio—10 amp and electric fuel—20 amp.

Pressure	3 to 4½ psi at 12.6 volts min.
Volume (At Idle)	1 PT 30-45 Seconds

NOTE: Black ground wire should be attached to the pump terminal closest to the tank unit float.

FORM NO: 690-750-039
LITHO IN U.S.A.

HARLEM & AVONDALE CHICAGO, ILLINOIS 60631

Sun SERVICE CONTROL SYSTEM

NAME ____________________

DATE ____________________

SPECIFICATION CARD QUIZ

Use 1975 Specification and Supplementary Cards

1. Year ____________________
2. Car Make ____________________
3. Number of Cylinders ____________________
4. Displacement ____________________
5. Carburetor ____________________
6. Transmission Type Auto Trans.
7. w/wo Anti Pollution Equip. with
8. w/wo Air Conditioning with
9. Spec. Card Number ____________________
10. Supplemental Card Number ____________________

11. COMPRESSION PRESSURE (Engine Section) — Spec. ________ PSI

12. COMPRESSION VARIATION (Engine Section) — Spec. ________ PSI Max. Var.

13. DISTRIBUTOR ROTATION (Engine Section) — Spec. ________ Rotation

14. IDLE MIXTURE LEAN DROP (Supplementary Card) — Spec. ________ to ________ DR RPM

15. TIMING BELT TENSION (Engine Section) — Spec. ________ to ________ Ft/Lb

16. CRANKING VOLTAGE (Starting Section) — Spec. ________ Volts (Min.)

17. RATED AMP OUTPUT (Charging Section) — Spec. ________ Amps ± ______ %

18. OPERATING VOLTAGE (Charging Section) — Spec. ______ to ______ Volts @ ______ ° F

19. DWELL (Ignition Section) — Spec. ____________________

20. COIL OUTPUT (Ignition Section) — Spec. ________ KV Min.

SPECIFICATION CARD QUIZ (con't.)

21. IGNITION TIMING Spec. ________ ° ________ TDC @ __________ RPM
(Ignition Section)

22. IGNITION ADVANCE @ 2500 RPM Spec. ________ ° to ________ °
(Charging Section) Spec. ________ ° to ________ ° Cent. Only

23. IDLE SPEED Spec. ______ Sol. Energized ______ Sol. De-ener.
(Fuel Section)

24. FUEL PUMP PRESSURE Spec. ________ to ______ PSI @ _______ Volts Min.
(Fuel Section)

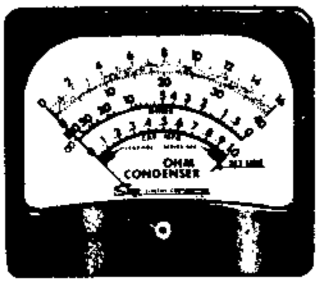
25. FUEL PUMP VOLUME Spec. ________ PT @ ________ to ________ Sec.
(Fuel Section)

26. REFRIGERANT CAPACITY Spec. ___________ Lb. ___________
(A/C Section)

27. BALLAST RESISTOR Spec. ________________
(Ignition Coil)

ZEROING SUN METERS and GAUGES

Follow these instructions before using a tester to assure the basic accuracy of its readings. Meters should be checked for correct zero position and adjusted as follows:

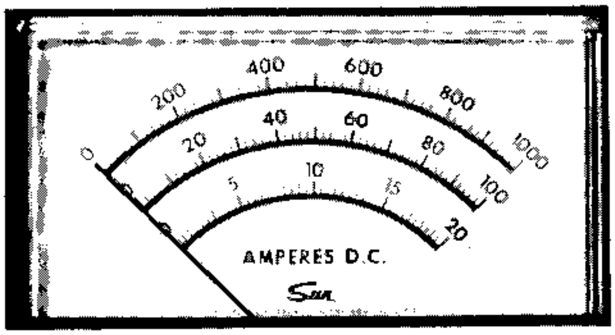


1. Turn the AC power switch OFF and disconnect any connections made to the vehicle.

2. Wait 30 seconds to permit circuits of the tachometer, dwellmeter, etc. to discharge.

3. a. Meters which zero at left end of scale: turn the zero corrector button on the front of the meter to the left or right until the needle is on the "0" line.

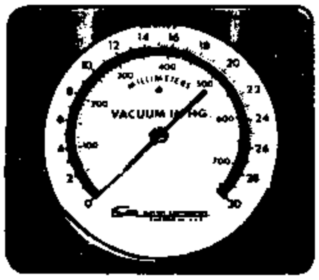
   b. Meters with center scale Set Lines turn the zero corrector button on the front of the meter to the left or right until the needle is on the SET LINE.



   c. Gauges of the Vacuum Gauge type:

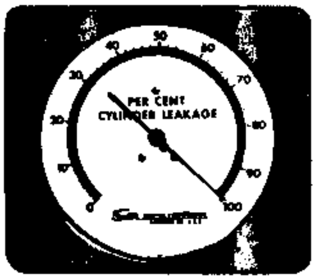
      1. Remove the rubber plug from the glass meter face.

      2. Use a small screwdriver and turn the adjusting screw on the meter face, left or right until the needle rests on 0.



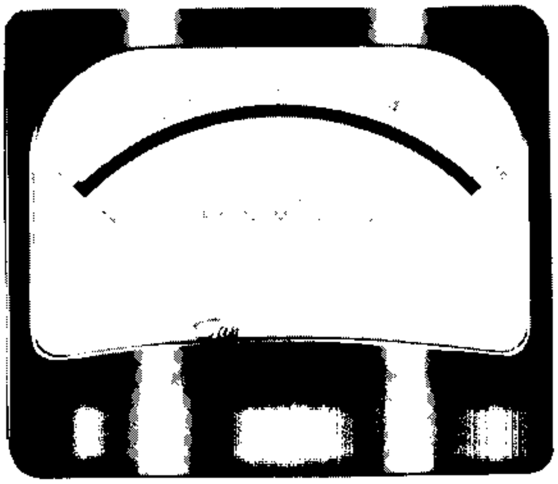
   d. Gauges of the Cylinder Leakage type:

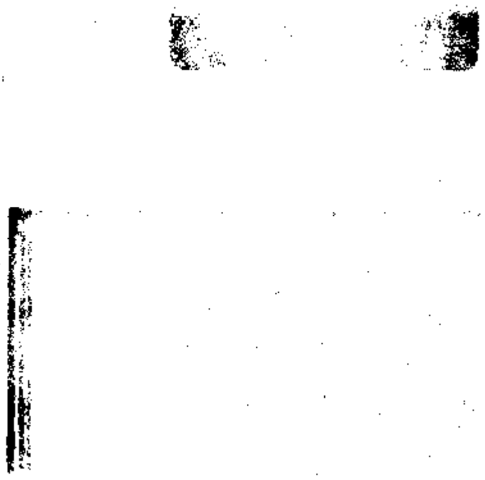
      No zeroing required.



INFRA-RED CO METER

1. Turn the zero corrector button on the front of the meter, left or right, until the needle is on the 0 line at the left end of the scale.

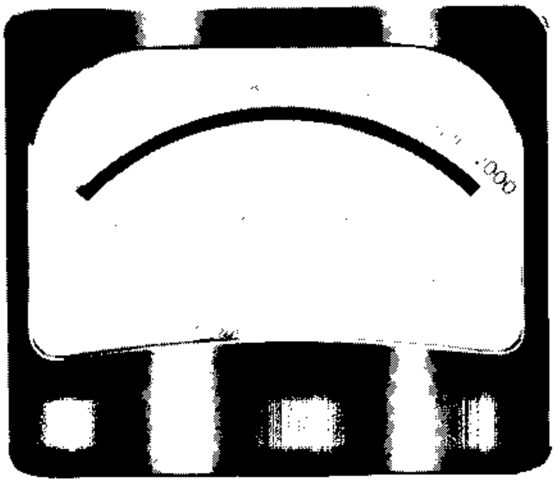




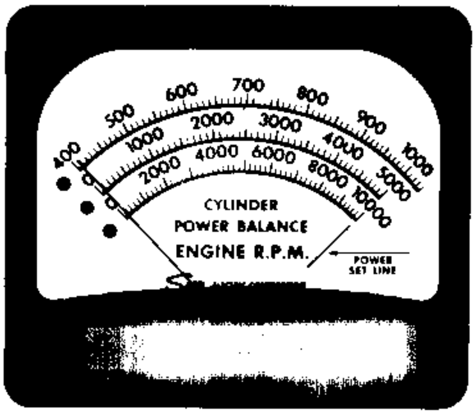
To zero these meters turn the OFF /STANDBY/TEST switch to OFF.

INFRA-RED HC METER

1. Turn the zero corrector button on the front of the meter, left or right, until the needle is on the 0 line at the left end of the scale.



TACHOMETER
USED ON MODELS EET-1160, 945, 947

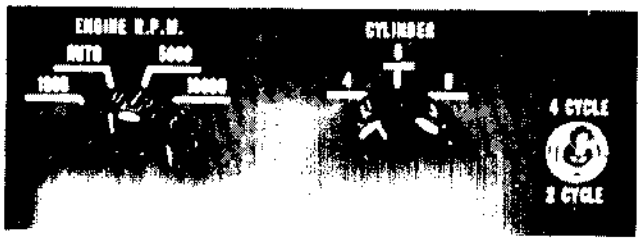


The Tachometer measures the engine's operating speed in revolutions per minute (RPM). Use the Tachometer to set idle speed and idle mixture, to test the PCV System. It is also used while following manufacturer's setting and testing procedures for exhaust emission control equipment.

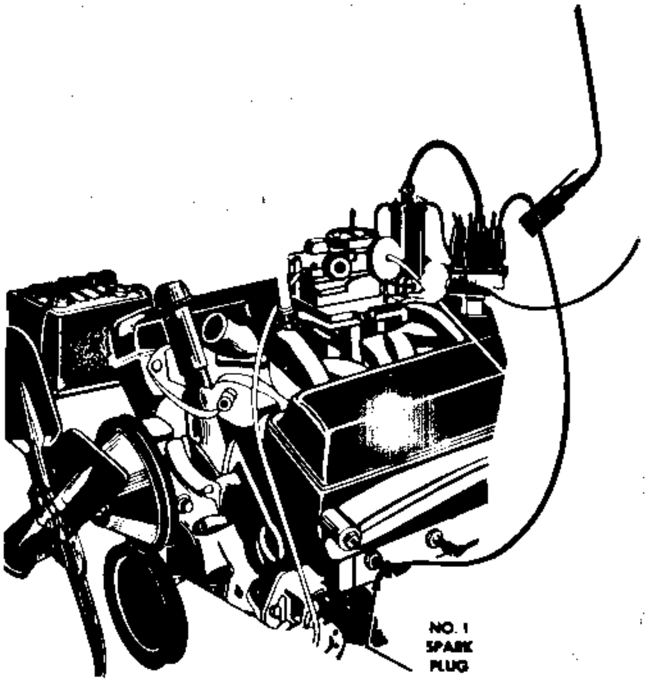
The Tachometer uses three RPM scales: 1000, 5000, and 10,000. When testing an engine, read the scale whose Indicator Light is on.

You set two controls before testing an engine:

1. Set the engine CYCLE selector to 2 CYCLE or 4 CYCLE. Note: for Wankel (rotary) type engines use the 2 CYCLE position.
2. Set the ENGINE RPM selector to 1000, AUTO, 5000 or 10,000 depending on the speed range of the test.



In the AUTO position the Tachometer will read engine speeds from 400 RPM to 5000 RPM by automatically switching back and forth between the 1000 and 5000 scales. You don't have to touch the ENGINE RPM Selector. An Indicator Light will tell you which scale to read. The Tachometer can be manually changed to the 1000, 5000, or 10,000 RPM scales.



HOOK UP

To hook up the Tachometer simply place the clamp-on Trigger pick-up over the NO. 1 spark plug wire near the distributor.

AREA TESTS

Idle Speed

To measure the idle RPM.

1. Clamp the Trigger pick-up onto the NO. 1 plug wire.
2. Set the engine CYCLE Selector to the position that matches the type of engine to be tested.
3. Set the ENGINE RPM Selector to AUTO.
4. Start engine and measure idle speed after the engine is warmed up.

   GOOD Idle speed at specified RPM.

   BAD If the idle speed is more than 10 RPM from specified, it should be readjusted.

Idle Mixture

Follow these steps to adjust the idle mixture on pre-emission control engines only. For emission controlled engines, follow the manufacturers' procedures for adjusting and testing.

1. Set idle speed to specified RPM by adjusting idle speed screw.
2. Adjust the carburetor idle mixture screw(s) for maximum RPM.
3. Readjust engine idle speed to specified RPM.

PCV TEST

Make this test to determine if the PCV system is functioning properly.

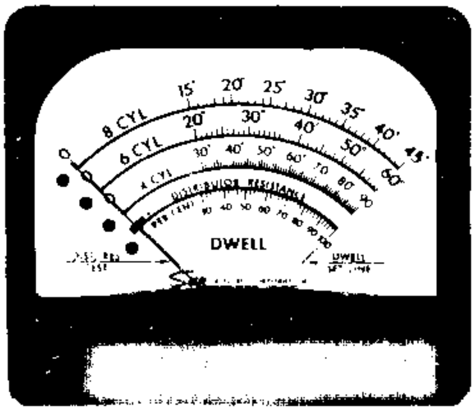
1. Operate engine at idle.
2. Note idle RPM.
3. Pinch off PCV hose or close off the end of the PCV valve.
4. Record the engine RPM.

   GOOD Engine RPM drops a minimum of 50 RPM.

   BAD The engine speed does not change or changes less than 50 RPM indicates the PCV system requires service. Clean or replace the PCV valve and hoses.

DWELL METER
USED ON MODELS EET-1160, 945, 947

Dwell is the period of time that the ignition points remain closed. The Dwell Meter measures this period of time in degrees of distributor cam rotation and gives you a reading of the average dwell of all the cylinders.



The Dwell Meter is used to adjust the dwell of the Ignition Points. You also use it to test the initial dwell setting at idle speed and the variation from this initial setting as engine speed is increased to 1500 RPM. Variation beyond the specified amount indicates mechanical problems in the distributor. The Dwell Meter is also used to test for excessive electrical resistance in the points, leads and ground connections. The Dwell Meter has four scales. Three of them are divided into degrees to indicate 4, 6 and 8 cylinder dwell. The fourth scale gives you a reading in percent of dwell. You can use this scale when testing an engine with a number of cylinders other than 4, 6 or 8. An Indicator Light next to each scale tells you which scale to read.

Before using the Dwell Meter, set three controls:

1. Set the CYLINDER Selector to 4, 6 or 8 to match the number of cylinders on the engine to be tested. This lights the Indicator Light on the corresponding scale.
2. Set the DWELL/DISTRIBUTOR RESISTANCE Switch to DWELL position.
3. Use the DWELL CAL knob to bring the needle to the set line. It is not necessary to connect the Dwell Meter leads together during calibration.

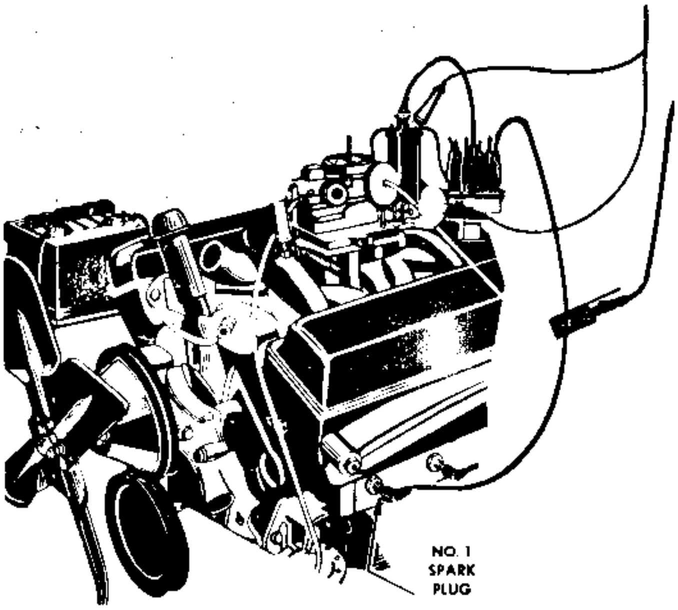
DWELL METER

Follow these steps to measure or set the dwell of the ignition points:

1. Connect the Trigger pick-up lead to NO. 1 cylinder spark plug.
2. Connect the red clip-on lead of the Pattern Pickup lead to the distributor terminal of the coil.
3. Connect the black clip-on lead of the Pattern Pickup to a good engine ground.
4. Start the engine; set idle to specified RPM.
5. Read Dwell Meter.

   GOOD Dwell within specifications.

   BAD Dwell not within specifications. Check condition of contact points and then reset.



DWELL VARIATION

Make this test to determine if worn components in the distributor are causing a change in dwell as engine speed increases:

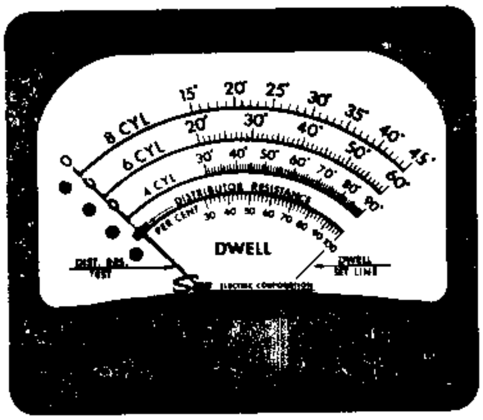
1. Move the Engine RPM knob to Auto.
2. Increase the engine speed to 1500 RPM or to speed specified by Mfg.

   GOOD Maximum change within specifications or if not specified, not more than 3 degrees.

   BAD Excessive change in dwell indicates worn components in distributor. Remove distributor for further testing and service.

DISTRIBUTOR RESISTANCE TEST

Make this test to determine if there is excessive electrical resistance in the distributor primary circuit. This test checks the ignition points, wire connections, distributor pigtail lead and the distributor ground.



1. Place the DWELL/DIST. RES Switch in the DIST. RESISTANCE position.

2. Crank the engine to make sure the ignition points are closed. When the points close, the dwell meter's needle will move toward the left end of the scale.

3. Turn the ignition switch on and note the position of the DWELL METER needle.

   GOOD Needle rests in the BLACK BAND at the left end of the Per Cent Dwell Scale.

   BAD If the needle reads out of the black band, there is excessive resistance in the distributor's primary circuit. Check the contract points for dirty, burnt or pitted contacts. Also check for poor lead connections, broken pigtail leads or a bad distributor to engine block ground.

NAME ____________________

DATE ____________________

TACHOMETER AND DWELL METER WORKSHEET

Eng. No. ____________________ Make/Year ______________

		GOOD	BAD
IDLE RPM (within 10 RPM of specification) Spec ______________ RPM	Measured ______________ RPM	☐	☐
PCV TEST (50 RPM drop with PCV closed off) Idle RPM ___________ RPM	Measured ______________ RPM	☐	☐
DWELL (within specification) Spec ______________°	Measured ______________°	☐	☐
DWELL VARIATION (within specification or if not specified more than 3°) Spec ______________°	Measured ______________°	☐	☐
DISTRIBUTOR RESISTANCE (black band)	Measured ___ IN ___ OUT	☐	☐

VACUUM GAUGE

The vacuum gauge is used to measure engine intake manifold vacuum. You can use it to measure the vacuum during cranking, to indicate mechanical problems in the engine, and at idle to indicate mechanical problems and incorrect timing. It is also used in some procedures as an indicator of idle mixture setting. At high engine speed it can indicate a restriction in the exhaust system. The vacuum gauge may also be used to check the amount of vacuum produced by auxiliary sources of vacuum, such as a vacuum booster pump, to test the efficiency of a fuel pump and to determine the amount of vacuum in control circuits for various accessories such as vacuum operated headlight covers.

The vacuum gauge uses the black rubber hose lead. A VACUUM DAMPER is fitted to some models and is turned to damp out excessive needle oscillations. Other models have an internal, non-adjustable damper to accomplish this damping action. Accessory fittings, hoses, tees and screw-in adapters are used to connect the test hose to the source of manifold vacuum.

AREA TESTS

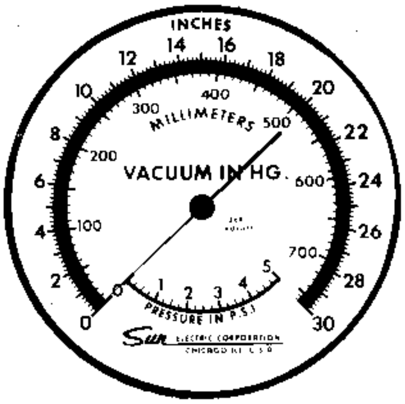
CRANKING VACUUM

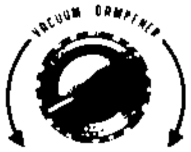
Make this test to detect problems such as burnt valves, broken rings, blown head gaskets or cracked heads or block, which might affect compression.

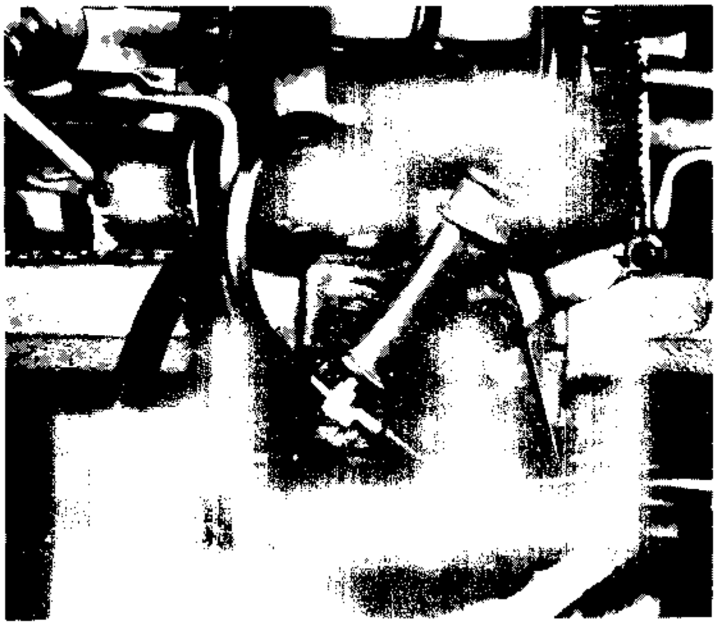
1. Connect the vacuum hose to a source of intake manifold vacuum. Use Tee adapter, hoses or screw-in adapter as required.

2. Ground the coil high tension lead so the engine will not start. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.

3. Crank the engine and note the action of the vacuum gauge. If the vacuum is very low, less than 1" it may be necessary to back out the idle speed control or disconnect the electrical throttle stop solenoid in order to increase cranking vacuum to a higher, more readable level.







GOOD A steady vacuum reading that is even and has a rhythmic pulsation indicates a mechanically sound engine.

BAD A compression leak will cause the vacuum gauge to drop toward zero each time the bad cylinder is on its intake stroke. Test this engine using the cylinder leakage and compression testers to pinpoint the compression loss.

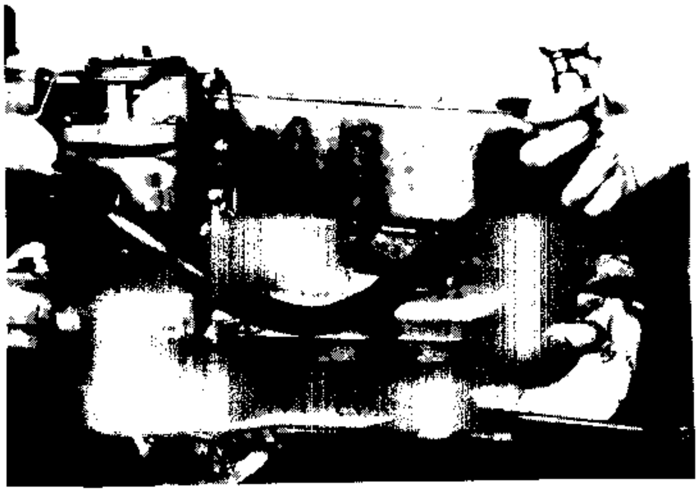
PCV TEST

Make this test to determine if PCV system is working properly.

1. While cranking the engine, pinch the PCV hose or close the end of the PCV valve to prevent air from leaking into the intake manifold.
2. Watch the vacuum gauge.

   GOOD An increase in vacuum indicates a good PCV system.

   BAD Very little or no change in vacuum indicates a bad PCV system. Replace the PCV valve and be sure the PCV hose is clear.



IDLE VACUUM

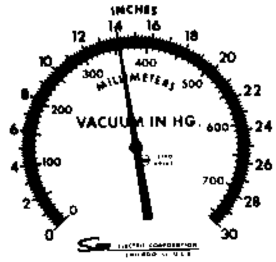
Make this test to determine if there are any problems with compression leak in the cylinders, or intake manifold or sticking valves, improper timing or fuel mixture which may affect idle vacuum.

1. Reconnect high tension coil lead. Readjust the idle speed control or reconnect any idle stop solenoids disconnected during the cranking tests.
2. Start the engine and run at a specified idle RPM.

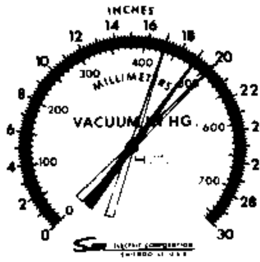
   GOOD A steady vacuum (between 15" to 22" indicates the engine is in good condition and is operating normally.

   BAD A pulsating or low vacuum indicates problem in the mechanical, ignition or fuel systems. Run additional tests using the cylinder leakage tester to pinpoint the problems.

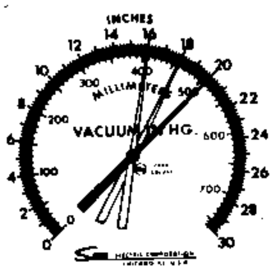
Low steady vacuum indicates manifold leak or incorrect timing.



Needle moves back and forth indicates carburetor mixture is incorrect.



Regular needle pulses compression loss in one or more cylinders.



IDLE MIXTURE

Make this test to adjust the idle mixture screw for proper mixture on pre-emission control engines only. For emission control vehicles, follow the manufacturer's procedures for setting and testing.

1. Set the idle speed to the specified idle RPM by adjusting the idle speed screw.
2. Peak the vacuum reading by adjusting the idle mixture screw or screws. Hold the idle RPM to specifications by adjusting the idle speed screw.
3. Evaluate the results with the combustion efficiency meter.

EXHAUST RESTRICTION

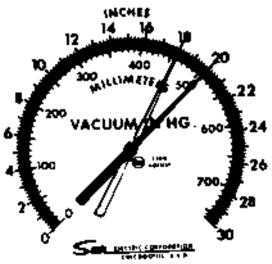
Make this test to determine if a **serious exhaust restriction** due to a plugged tail pipe, collapsed muffler or header pipe exists.

1. Run the ending at idle RPM and note the vacuum reading.

2. Increase the engine speed to 2500 RPM and note reading.

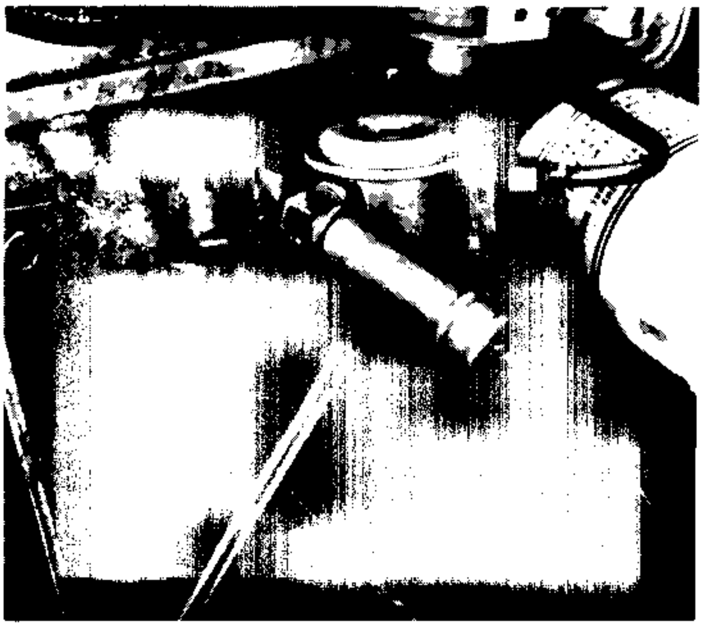
   GOOD An increase in vacuum over idle vacuum indicates no restrictions in the exhaust system.

   BAD A decrease in vacuum indicates a restriction in the exhaust system which will affect performance.



DETAIL TESTS
FUEL PUMP VACUUM TEST

Make this test to determine if the fuel pump develops enough vacuum to pull fuel from the tank and if the check valves in the pump are working properly.



1. Disconnect input fuel line from fuel pump.

2. Connect vacuum hose to input of fuel pump. Use an adapter as necessary.

3. Start the engine and run at idle or specified RPM.

4. Watch the vacuum gauge. It may require several minutes for fuel level in carburetor float bowl to drop sufficiently to cause the fuel pump to operate. If the FUEL PUMP TESTER is connected, this may be speeded up by placing the volume hose into a container and opening the clamp. Allow the vacuum gauge to reach the maximum reading.

5. Stop the engine. Watch the vacuum gauge.

   GOOD Vacuum gauge reads within specifications if listed or at least 10" if not listed and holds this reading for at least 30 seconds.

   BAD If the vacuum is below specification or less than 10", if not specified, or the vacuum reading does not hold for 30 seconds, then problems in the fuel pump such as a leaking diaphragm or bad check valves are indicated.

VACUUM GAUGE

VACUUM BOOSTER TEST

Make this test to determine if the vacuum booster or auxiliary source of vacuum produces sufficient vacuum.

1. Connect vacuum hose to input port of booster.
2. Operate engine at idle and note vacuum reading.

   GOOD Above minimum operating specification of booster or if not specified above 8".

   BAD If below the specified amount then repair or replace the booster.

VACUUM OPERATED ACCESSORIES

Make this test to determine if sufficient vacuum is applied to operate the accessories.

1. Connect vacuum hose to control lines using TEE fitting and short length of hose.
2. Run engine at idle.
3. Operate accessory and watch vacuum gauge.

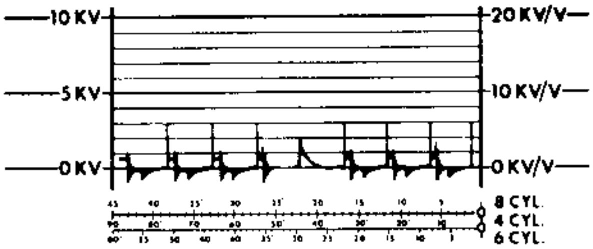
   RESULTS See the manufacturer's shop manual for minimum vacuum required for operation. If below minimum check for leaks in the lines.

9. Repeat steps 7 and 8 for each cylinder in the engine, pausing long enough to record the RPM for each cylinder.
   The CANCEL button may be used in place of pressing each cylinder button a second time.

10. Compare RPM figures recorded in Steps / and 8.

    GOOD less than 30 RPM difference between cylinders.

    BAD more than 30 RPM difference indicates an engine with unequal power output from the cylinders. Check the mechanical system using the Cylinder Leakage tester, the ignition system using the Sun Scope, and the Fuel System with the Combustion Efficiency tester or Infra-Red Tester.



Appearance of scope pattern with one cylinder shorted out.

NAME ____________________
DATE ____________________

COMPRESSION SYSTEM TESTING WORKSHEET

Eng. No. ____________________ Make/Year ____________________

AREA TESTS Tests to quickly determine an engine's condition. GOOD BAD

CRANKING VACUUM ☐ ☐
(Steady reading)

PCV TEST ☐ ☐
(Increase in cranking vacuum with PCV pinched)

IDLE VACUUM ☐ ☐
(Steady vacuum, 15" to 22") ____________________"

EXHAUST RESTRICTION ☐ ☐
(Vacuum increases at higher RPM)

CYLINDER BALANCE ☐ ☐
(Less than 30 RPM difference)

Cylinder #								
RPM								

RPM at start ____________________
RPM at end ____________________
(no change in RPM) ____________________

DETAIL TESTS Tests to pinpoint the problem.

COMPRESSION ☐ ☐
(Within specifications)

Cylinder #								
PSI								

Specifications (from card):
__________ PSI
__________ Variation

CYLINDER LEAKAGE ☐ ☐
No leakage at valves or head gasket, less than 20% leakage

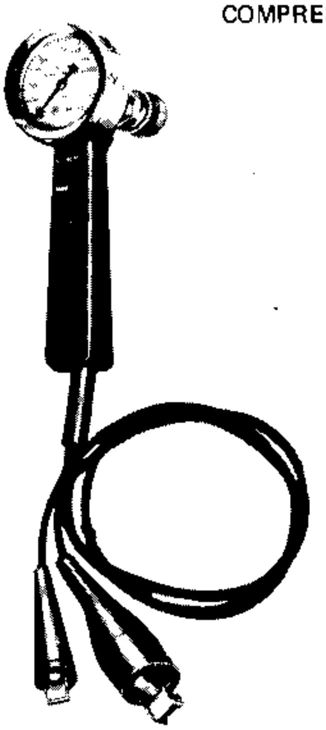
Cylinder #								
% Leakage								

Indicate location of leakage: I - intake valve E - exhaust valve H - head or head gasket
R - piston rings

COMPRESSION TESTER

The Compression Tester measures the amount of pressure built up in a cylinder while cranking during the compression stroke. The tester can indicate losses in compression through the rings, valves, or head gasket. It will also show excessive carbon build up in cylinders.

The compression tester uses a hand held gauge with a CRANK-VENT switch to allow remote cranking of an engine. The threaded tester hoses are used to connect the gauge to the engine. These hoses have a special rubber ring that makes a positive seal in the spark plug hole with only hand tightening.



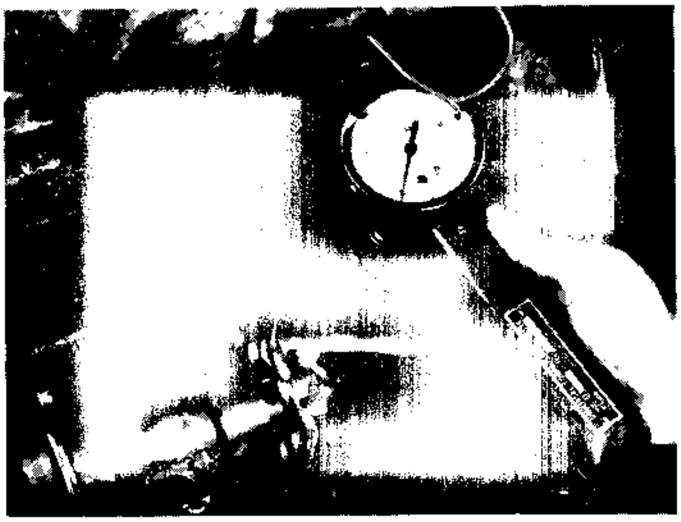
COMPRESSION TEST

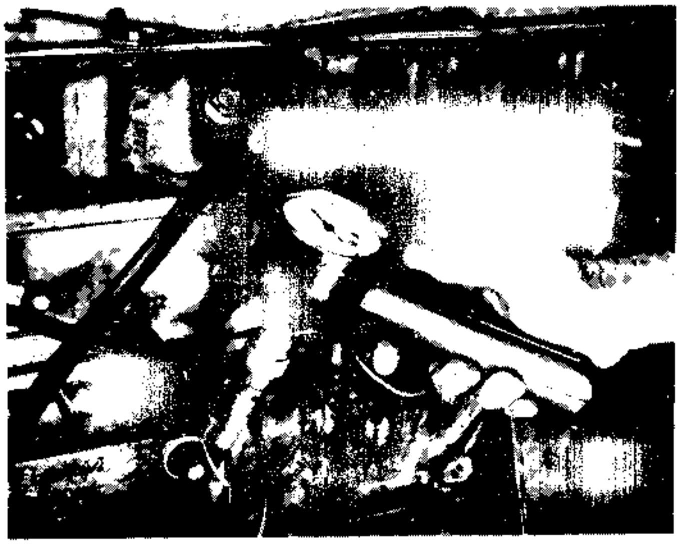
Make this test to detect compression leaks as indicated by the vacuum or cylinder balance tests. Compression testing can also detect excessive carbon build-up in a cylinder.

1. The engine should be at normal operating temperature for this test.
2. Remove all the spark plugs.
3. Set throttle and choke wide open.
4. Ground out the coil's high tension lead and turn the ignition switch ON. If the vehicle has a non-standard ignition system, refer to manufacturer's procedure. Be sure the vehicle's battery has a sufficient charge to crank the engine at a normal speed.
5. Connect the tester's electrical leads to the starter solenoid or the control circuit.
6. Screw the proper test hose into the spark plug hole and connect the other end to the tester.
7. Crank the engine for 4 compression strokes: note the first and last reading.
8. Vent the compression tester and move to the next cylinder.

   GOOD Compression pressures on final stroke are within the specified range.

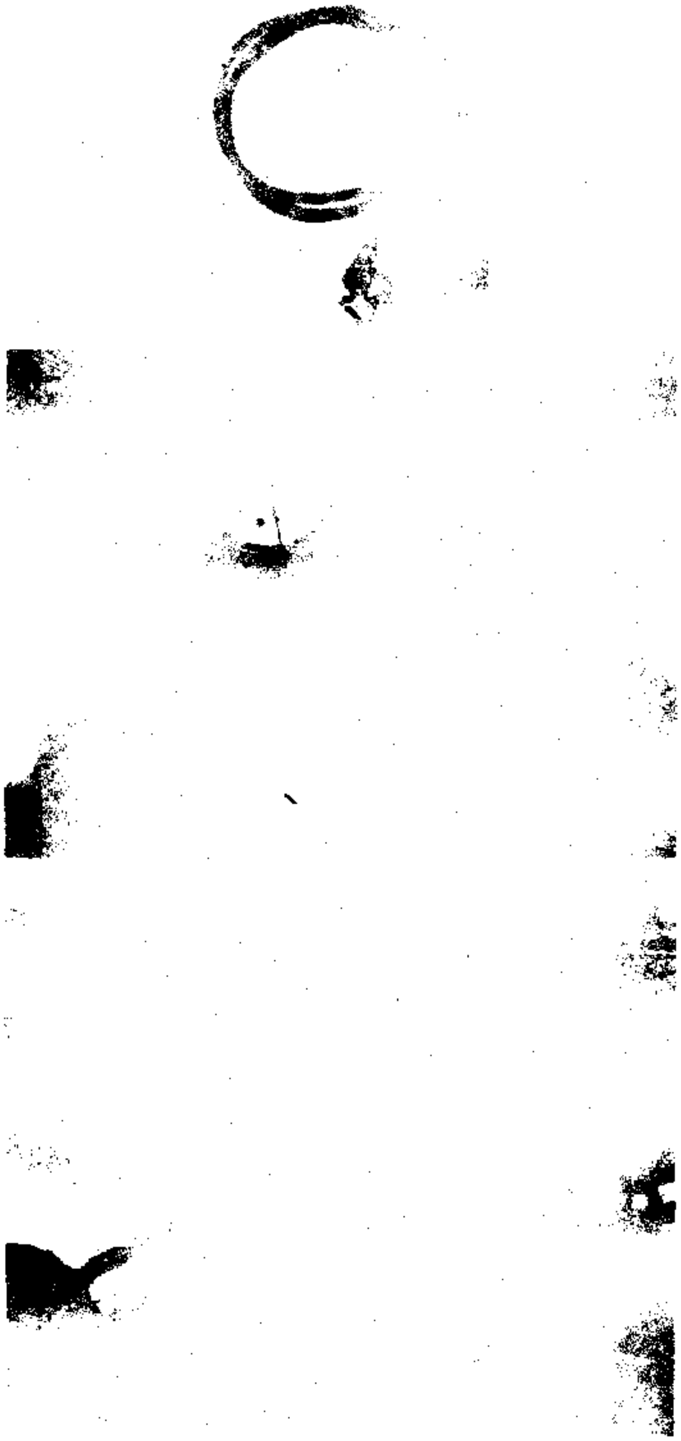
   BAD First stroke reading is low and pressure does not build to a good reading in the following strokes. Add a little oil to the cylinder and repeat the test. If readings are now good, the test indicated ring problems. If readings are still low then the test indicated either



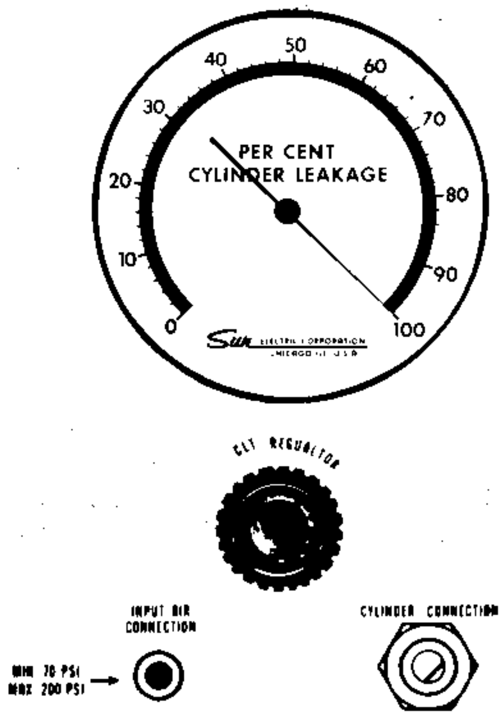


a valve or a head gasket problem. Inspect the spark plug for evidence of oil or water and test adjacent cylinders for similar problems.

Readings higher than normal indicate carbon build up in the cylinder.



CYLINDER LEAKAGE TESTER



The Cylinder Leakage Tester is used to determine the location and relative amounts of compression losses in an engine. This tester can locate leaks at intake and exhaust valves or head gaskets and excessive leakage past the rings.

The Cylinder Leakage Tester uses the % Cylinder Leakage gauge, the CLT Regulator, a tester hose and one of several adapter hoses for various types of engines.

The Tester requires an outside source of air pressure (70 to 200 psi) to be connected to the INPUT AIR CONNECTION. Before connecting this line to the input air connection, turn the CLT REGULATOR to the left a couple of turns. Then connect the air line and turn the CLT REGULATOR to the right until the gauge reads "0". Momentarily connect the tester hose to the output fitting. The gauge should rise, then return to "0". If it does not return to zero, turn the CLT REGULATOR to the left again and repeat. When the Cylinder Leakage Tester reads on "0" it is ready to be used. Connect the tester hose to the CYLINDER CONNECTION.

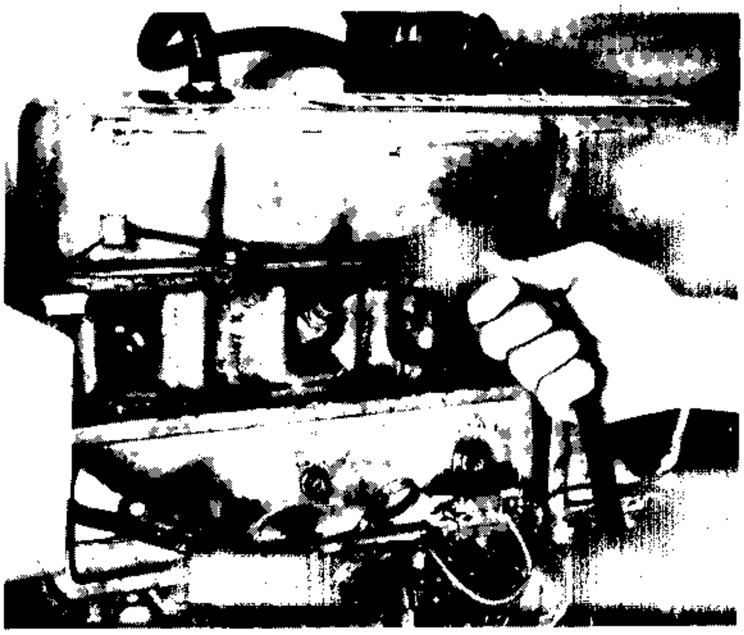
This air pressure will be applied to a cylinder when the piston is at TDC on the compression stroke. At this time both intake and exhaust valves are closed and except for a small amount of air leaking past the piston ring gaps no air should escape from a good cylinder. The amount that does leak out is measured on the % CYLINDER LEAKAGE gauge.

DETAIL TEST

CYLINDER LEAKAGE

Make this test to determine the location of compression losses indicated by the vacuum or cylinder balance tests.

1. Remove spark plugs from cylinders to be tested and radiator and crankcase filler caps.



2. Ground out the coil's high tension lead. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.

3. Connect the remote starter switch to the starter solenoid. Turn ignition key ON.

4. Screw the proper adapter hose, finger tight, into the cylinder to be tested and put the whistle on the end of the hose.

5. Crank engine over slowly until whistle stops sounding. Remove whistle.

6. Connect the tester hose to the adapter hose. Watch the engine fan; if it turns, stop. Remove the tester hose and repeat Step 5. DO NOT ATTEMPT TO CRANK ENGINE WITH THE TESTER HOSE CONNECTED.

7. Listen for air leakage at exhaust pipe, radiator and carburetor and from the adjacent cylinders. If the engine has a PCV valve, be sure to pinch off PCV hose when listening at carburetor.

8. Look at gauge, record reading.

   GOOD No "air leaking" heard in exhaust pipe, radiator, carburetor or adjacent cylinders and leakage less than 20%.

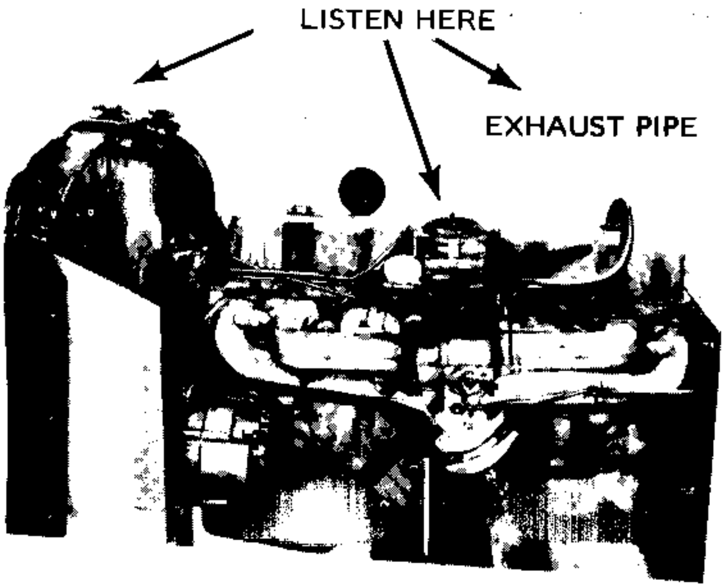
   BAD "Air leaking" heard at exhaust pipe, radiator, carburetor, adjacent cylinders or more than 20% leakage on a properly broken in engine, indicates a need for service.

   a. Air escaping at carburetor indicates a leak at the intake valve.

   b. Air escaping at exhaust pipe indicates a leak at the exhaust valve.

   c. Air escaping at radiator filler cap indicates a blown head gasket or cracked blocked.

   d. Air escaping from adjacent cylinders indicates a blown head gasket or cracked block.



   e. More than 20% leakage with no air leakage past the valves or the head gasket indicates excessive ring clearance.

If additional cylinders are to be tested:

9. Either repeat steps 4 to 6 or use the TDC indicator to bring cylinder to be tested up to the test position.

Name ____________________

COMPRESSION SYSTEM TESTING QUIZ

1. The cranking vacuum test is used to:

   A. Set the carburetor idle mixture

   B. Evaluate an engine's general compression condition

   C. Set ignition timing

   D. All of the above

2. A vacuum gauge can tell a mechanic:

   A. The exact location of compression leaks

   B. Cylinder balance or unbalance conditions

   C. Excessive carbon deposits exist in the combustion chamber

   D. All of the above

3. Compression losses at any point during engine operation may cause:

   A. Rough idle

   B. Hard starting

   C. Engine miss

   D. All of the above

4. During the compression test the engine is allowed to crank through how many complete cycles:

   A. One

   B./ Two

   C. Three

   D. Four

5. To detect a compression leak while using the cylinder leakage tester:

   A. Use a high voltage probe

   B. Listen at various parts of the engine

   C. Use a kerosene and oil mixture applied to suspected leak areas

   D. All of the above

6. **During the cylinder leakage test:**

   A. Intake and exhaust valves must be open

   B. Intake and exhaust valves must be closed

   C. Valves may be either open or closed

   D. Intake valve must be open

7. The high tension lead of the coil should be grounded with a jumper wire during which of the following tests:

   A. Compression test

   B. Cranking vacuum test

   C. Idle vacuum test

   D. A and B

8. The power balance test will quickly check the evenness with which each cylinder:

   A. Reaches maximum compression

   B. Performs the exhaust function

   C. Pulls its share of the load

   D. Ignites its fuel charge

9. Mechanic A says all spark plugs must be removed before performing a compression test.

   Mechanic B says just the spark plug of the cylinder being tested should be removed.

   A. A only

   B. B only

   C. Both A and B

   D. Neither A or B

10. Mechanic A says head gasket leakage can be detected by air leaking from the PCV valve during a leakage test.

    Mechanic B says the spark plugs of the adjoining cylinders should be removed before doing a cylinder leakage test to check for possible head gasket leakage.

    A. A only

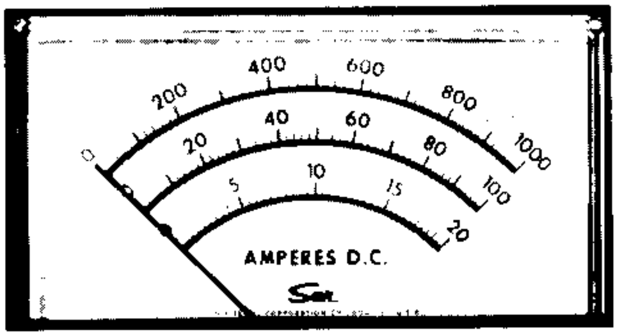
    B. B only

    C. Both A and B

    D. Neither A or B

AMMETER

The ammeter measures the amount of current flowing in an electric circuit. The Sun Ammeter can be used to measure ignition current or the field current of an alternator or generator, or any other current. The meter (meter scales) will vary from low range to high range. Depending upon the current draw of the circuit being measured, amperage can vary from less than 10 amps to several hundred amps. A low range scale is needed for reading low current values which could not be accurately measured on a high ammeter scale. The following is an example of ammeter application as applied to low current tests used to evaluate a typical automotive ignition and charging system.



DETAIL TESTS

IGNITION CURRENT WITH ENGINE STOPPED

Make this test to determine if improper current flow in the primary ignition circuit is the cause of: low coil output (current flow is too low due to excessive resistance) or contact point burning (current flow is too high due to low resistance in the primary ignition circuit).

1. Open the ignition primary circuit at any point.
2. Connect the ammeter leads so all current in the circuit will flow through the tester.
3. Turn ignition key on. If meter reads zero, bump engine over until the ignition contact points close.

   GOOD Ammeter reads specified ignition current with engine stopped, or if not specified, about 3.5 to 4 amps.

   BAD Lower than specified, indicates excessive resistance in the primary circuit components, connections or leads. Higher than specified, indicates lower than normal resistance in the primary circuit components.

IGNITION CURRENT, ENGINE IDLING

Make this test to determine if low coil output or contact point burning is due to improper resistance in the primary circuit while the engine is operating.

1. Start engine and read ammeter.

   GOOD   Ammeter reads specified ignition current with engine idling or if not specified, about 2.5 to 3 amps.

   BAD   Lower than specified, indicates excessive resistance in the primary circuit components, connections or leads. Higher than specified indicates too low a resistance in the primary circuit components.

ALTERNATOR OR GENERATOR FIELD CURRENT

Make this test to determine if the specified amount of current flows in the alternator or generator field circuit when detail testing charging system problems.

1. Connect the ammeter into the alternator or generator's field circuit.

2. Start the engine and operate it at 2000 RPM.

3. Turn on headlights or heater blower and read the meter.

   GOOD   Field current within specifications.

   BAD   Low current indicates excessive resistance in the alternator or generator's field windings, the regulator or connections. High current indicates shorted or grounded circuits in the alternator, generator, regulator or wiring.

NAME ____________________
DATE ____________________

ELECTRICAL COMPONENT TESTING WORKSHEET

Eng. No. ____________________ Make/Year ____________________

GOOD BAD

AMMETER

IGNITION CURRENT ☐ ☐
(within specification)
Spec Measured

engine stopped ____________ amp ____________ amp
engine idling ____________ amp ____________ amp

VOLTMETER

CRANKING VOLTAGE AT BATTERY ☐ ☐
(within specification)
Spec ____________ V Measured ______ V

CHARGING VOLTAGE ☐ ☐
(within specification)
Spec Operating voltage Measured

__________ V at ________ F ________ V

CRANKING VOLTAGE AT COIL ☐ ☐
(within Spec or .5V of battery voltage)
Spec ____________ V Measured ______ V

CIRCUIT RESISTANCE IN THE IGNITION BYPASS CIRCUIT ☐ ☐
(within specification)
Spec ____________ V Measured ______ V

CIRCUIT RESISTANCE IN A STARTER GROUND CIRCUIT ☐ ☐
(less than .2V)
Spec ____________ V Measured ______ V

OHMMETER

IGNITION COIL RESISTANCE ☐ ☐
(resistances within spec)
Spec Measured

Primary resistance __________ OHMS __________ OHMS
Secondary resistance __________ OHMS __________ OHMS

SPARK PLUG WIRES (RESISTOR TYPE) ☐ ☐
(within specification)
Spec __________ OHMS Measured 1. ____ 2. ____ 3. ____ 4. ____
5. ____ 6. ____ 7. ____ 8. ____

ELECTRICAL COMPONENT TESTING WORKSHEET (con't.)

BALLAST OR IGNITION RESISTOR — GOOD BAD
(within specification)
Spec ____________ OHMS Measured ________ OHMS ☐ ☐

COIL TESTER

IGNITION COIL
(scope test pattern) ☐ ☐

CONDENSER TESTER

CONDENSER TESTING
(within black bands and specifications) ☐ ☐

	Spec	Measured	
series resistance	black band	good	bad
leakage	black band	good	bad
capacity	______ MFD	________ MFD	

ELECTRICAL COMPONENT TESTING WORKSHEET (con't.)

GOOD BAD

BALLAST OR IGNITION RESISTOR
(within specification)
Spec ____________ OHMS Measured ________ OHMS ☐ ☐

COIL TESTER

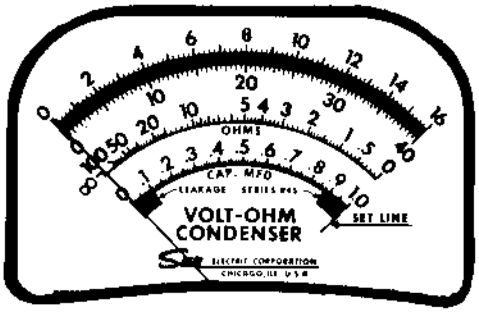
IGNITION COIL
(scope test pattern) ☐ ☐

CONDENSER TESTER

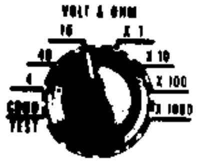
CONDENSER TESTING ☐ ☐
(within black bands and specifications)

	Spec	Measured	
series resistance	black band	good	bad
leakage	black band	good	bad
capacity	______ MFD	_______	MFD

The Voltmeter measures the amount of electric pressure in a circuit. The Sun voltmeter is used to measure the voltage in any battery circuit or the primary ignition circuit of a vehicle.



Examples of useful voltage measurements are cranking voltage, the battery's voltage while cranking the engine, charging voltage, the voltage at which the charging system operates, and applied voltage, the amount of voltage put into a circuit or accessory. In addition, the voltmeter may be used to measure circuit resistance, the amount of voltage lost because of excessive resistance in a circuit.



The Voltmeter uses the twin-flex cable, the Red clip is positive (+) the Black Clip is negative (-).

The VOLT & OHM selector knob is used to select the scale or range of voltage being read on the multiple-scale meter.

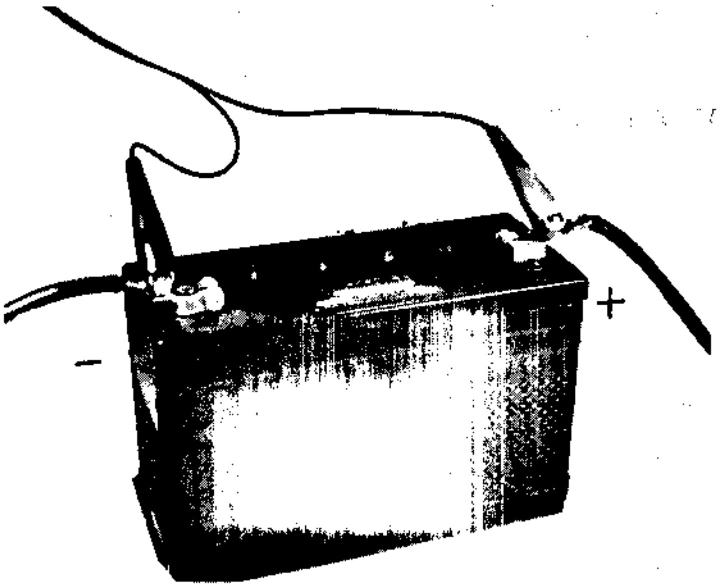
AREA TESTS

CRANKING VOLTAGE

Make this test to detect problems in the battery, starter motor or starter circuit, leads, connections or starter solenoid which may cause the battery's voltage to drop and cause starting problems.

1. Set the VOLT & OHM control to 16V range, for 6 & 12 volt systems.
2. Connect the Voltmeter leads to the battery, Red to the + terminal, Black to the - terminal.
3. Ground out the coil's high tension lead so the engine will not start. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.
4. Crank the engine for five seconds and record Voltmeter reading.

   GOOD Voltage remains above minimum specified on specification card or above 9.6 Volts if not specified.



BAD Voltages below specification indicate:

a. The battery is not fully charged or will not not accept a charge. Test battery and charging system independently.
b. The starter, the solenoid or the lead connecting them to the battery is the problem.

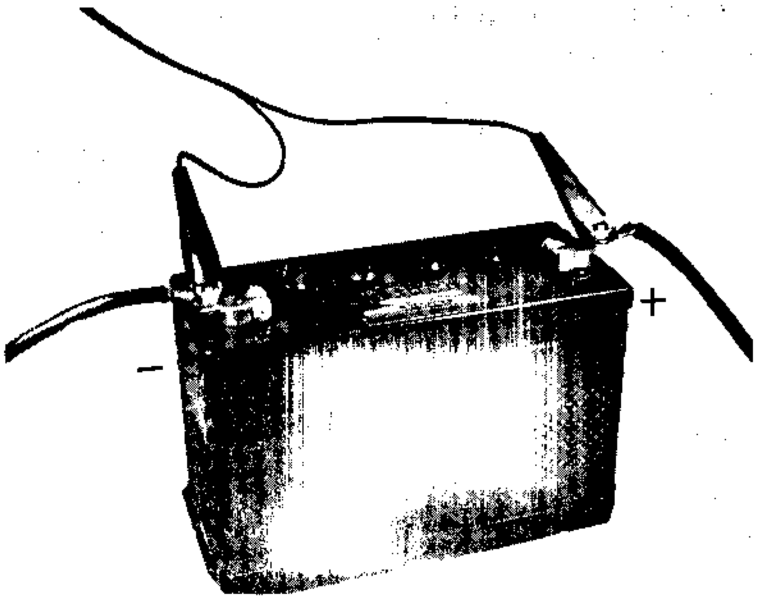
CHARGING VOLTAGE

Make this test to detect problems in the voltage regulator, generator or alternator or charging system circuit which may prevent proper charging of the battery.

1. Set the VOLT & OHM Selector to 16V.
2. Connect the Voltmeter leads to the battery, Red to + terminal, Black to - terminal.
3. Start the engine and run at 2000 RPM or the specified test speed.
4. Record the voltmeter reading.

   GOOD Voltage within charging system operating voltage specification.

   BAD Voltage too low indicates a defective generator or defective or misadjusted regulator. Voltages too high indicate a misadjusted or defective regulator or excessive circuit resistance in the system.



DETAIL TESTS

VOLTAGE PUT INTO CIRCUIT

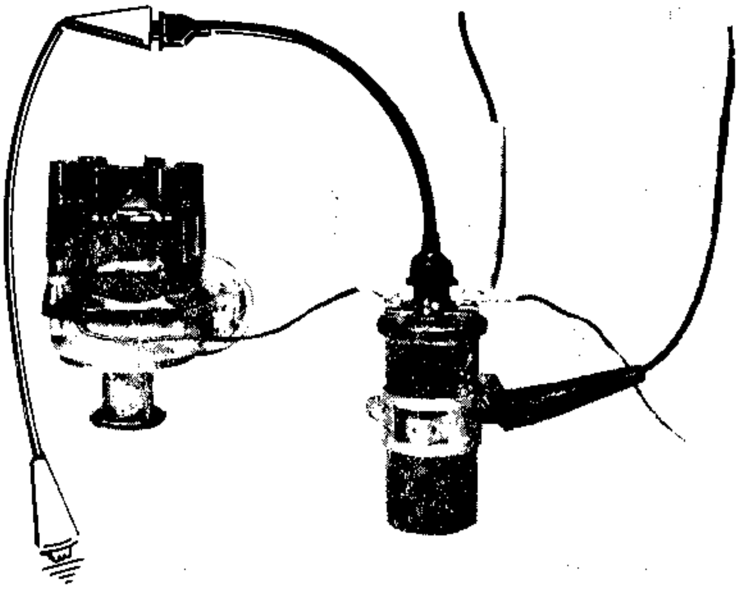
Make this test to determine if the proper voltage is supplied to a component or circuit or if circuit resistance in wires, connections or switches are lowering the voltage below the normal operating range.

Example: Voltage at coil during cranking.

1. Set the VOLT & OHM Selector to 16V.
2. Connect the Black Voltmeter lead to ground, the Red lead to the battery terminal of the coil.
3. Ground out the coil's high tension lead. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.
4. Crank engine, record voltmeter reading.

   GOOD Voltage at coil within 1/2V (.5V) of voltage at battery during cranking.

   BAD Low voltage indicates excessive circuit resistance in the leads, switches or connections between the coil and battery.



Other examples of Voltage put into a circuit are: voltage supplied to headlight circuits, and voltage supplied to the heater motor circuit.

CIRCUIT RESISTANCE IN AN INSULATED CIRCUIT

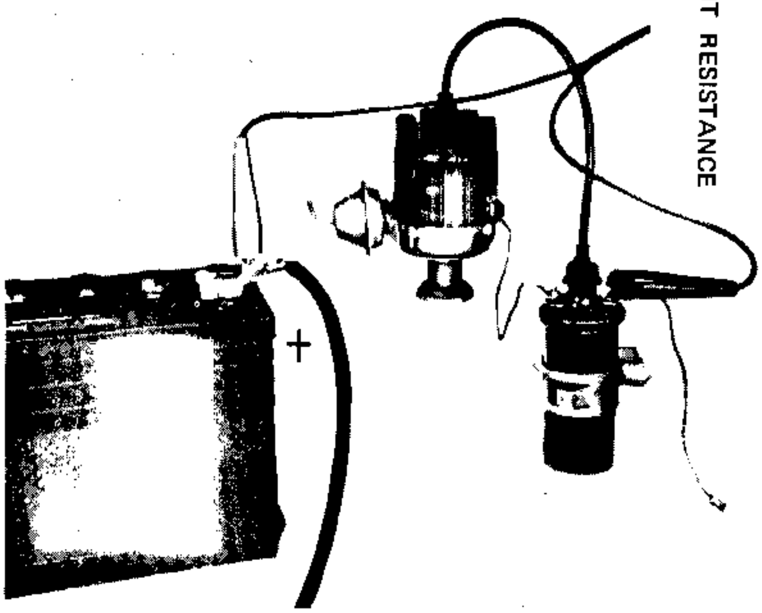
Make this test to locate the point of circuit resistance in an insulated (hot) circuit.

Example: (circuit resistance in ignition bypass circuit).

1. Set the VOLT & OHM Selector to 4V.
2. Connect the RED voltmeter lead to the + terminal of the battery, the BLACK lead to + terminal of the coil.
3. Ground out the coil's high tension lead. If the vehicle has a non-standard ignition system, refer to the manufacturer's procedure.
4. Crank the engine and record the voltmeter reading.

   GOOD Voltmeter reads less than .5V, or as specified by the manufacturer.

   BAD Voltmeter reading of more than 1/2 V (.5V) indicates excessive circuit resistance. Pinpoint the location by moving the red lead to the next connection point in the circuitand reading voltmeter. When the reading drops the excessive circuit resistance was in the last wire, or connection. Maximum allowable circuit resistance is .3 Volt at any switch, .2 Volt in any lead, 0 at any connection.

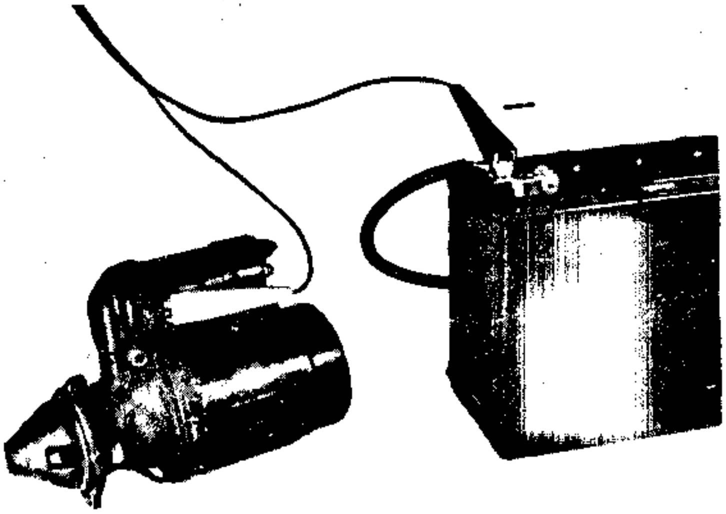


CIRCUIT RESISTANCE IN A GROUND CIRCUIT

Make this test to locate the point of circuit resistance in a ground circuit.

Example: Circuit resistance in the starter ground circuit.

1. Set VOLT & OHM Selector to 4 V.
2. Connect the RED voltmeter lead to the starter motor housing, the BLACK lead to the - (or neg.) battery terminal.
3. Ground coil secondary wire. If the vehicle has a non-standard ignition system, refer to manufacturer's procedure.
4. Crank the engine and note the voltmeter.



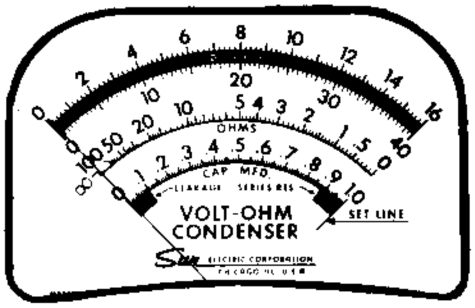
CIRCUIT RESISTANCE

GOOD Voltmeter reads less than .2V or as specified by manufacturer.

BAD Voltmeter reading of more than .2 V indicates excessive circuit resistance. Pinpoint the location by moving the red lead to the transmission or engine, then to the battery ground cable, etc., and read the voltmeter. When the reading drops, the excessive circuit resistance was in the last connection or wire. Maximum allowable circuit resistance is .1 Volt in any lead, 0 at any connection.

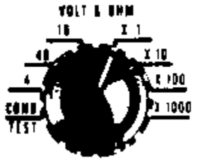
OHMMETER

The Ohmmeter measures the amount of electrical resistance in a circuit. It is primarily used in detail testing electrical components like coils, relays and spark plug wires.



Examples of typical resistance measurements are: resistance of primary and secondary windings of ignition coils, of ballast resistors and spark plug wires.

The Ohmmeter uses the black twin-flex cable. All measurements are made with the circuit open and with NO power applied.



The VOLT & OHM selector knob is used to select one of the four ranges of resistance to be measured. The Ohmmeter scale is read from right to left (opposite to the normal direction).
In the X1 position, read the scale directly.
In the X10 position, read the scale and add one zero to the reading.
Example – 4 becomes 40.
In the X100 position, read the scale and add two zeros to the reading.
Example – 4 becomes 400.
In the X1000 position, read the scale and add three zeros to the reading.
Example – 4 becomes 4000.

Always calibrate the ohmmeter after selecting the range by connecting the test leads together and turning the COND. OHM-COIL CALIBRATOR knob until the meter reads on the Set Line.

DETAIL TESTS

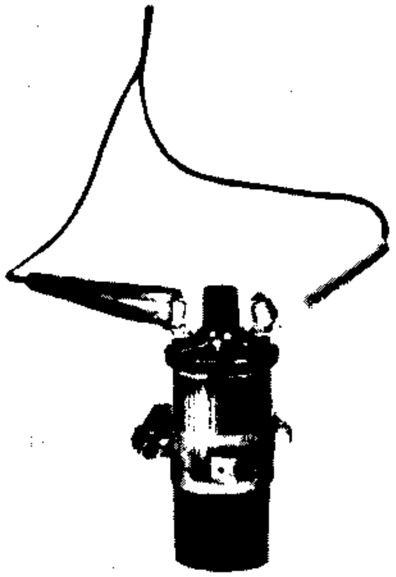
IGNITION COIL PRIMARY RESISTANCE

Make this test to measure the resistance of the primary windings of an ignition coil to determine if it is the correct value.

1. Set VOLT & OHM selector to X1.
2. Calibrate meter.
3. Disconnect the ignition leads from the coil.
4. Connect either test lead to the + terminal of the coil, the other lead to the - terminal.
5. Read the meter.

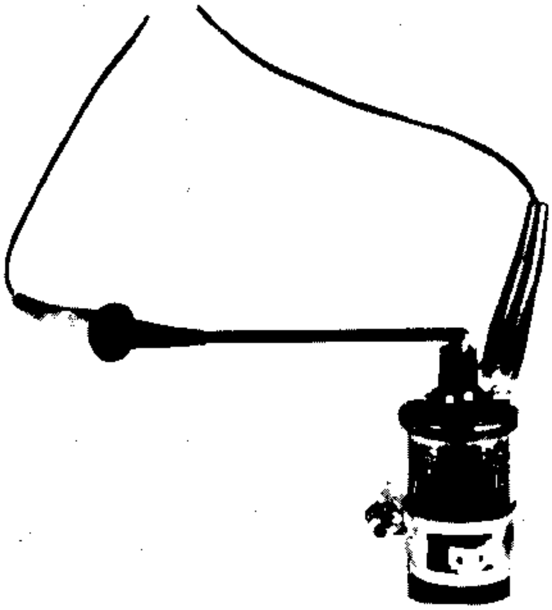
   GOOD Resistance is within specification when coil is at room temperature (has not been operated).

   BAD Resistance that is higher or lower than specified indicates an incorrect or damaged coil and that will affect ignition system performance.



IGNITION COIL SECONDARY RESISTANCE

Make this test to measure the resistance of the secondary winding of an ignition coil to determine if it is the correct value.



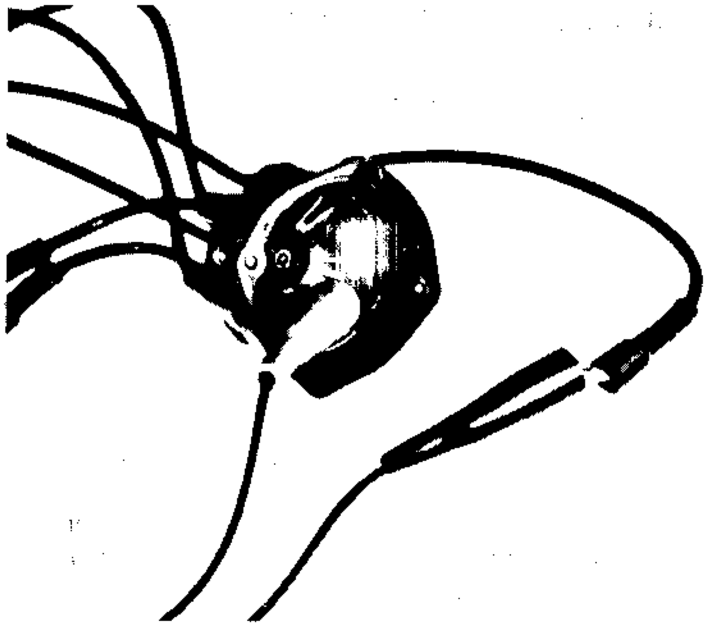
1. Set VOLT & OHM selector to X1000.
2. Connect either lead to the grounding probe.
3. Calibrate meter.
4. Connect one lead to either primary terminal of the coil.
5. Connect the other lead to the center tower of the coil with grounding probe.
6. Read meter.

GOOD Resistance is within specifications when coil is at room temperature (has not been operated).

BAD Resistance that is higher or lower than specified indicates an incorrect or damaged coil that will affect ignition system performance.

SPARK PLUG WIRE

Make this test to determine if a spark plug wire has any breaks or opens, or if it is a resistor type wire, that it has the correct resistance.



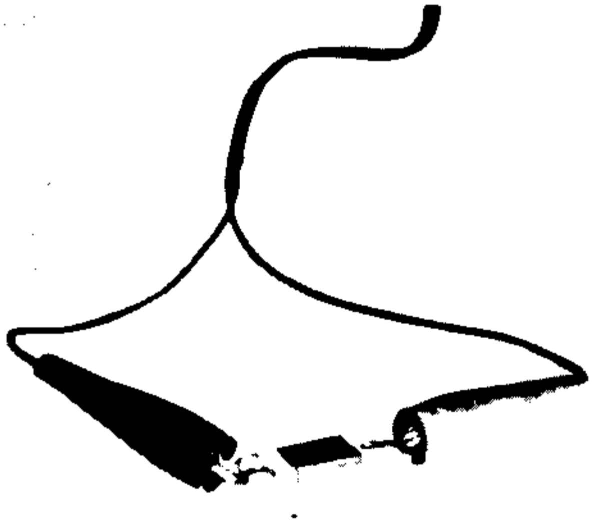
1. Set VOLT & OHM selector to X1000.
2. Calibrate meter.
3. Connect one lead to the spark plug end of wire.
4. Touch other lead to the insert inside the distributor cap.
5. Read meter.

GOOD Resistance is within specification or if not specified, it is less than 20,000 Ohms.

BAD Resistance that is not within specifications indicates a broken or otherwise damaged wire which will affect ignition system performance.

BALLAST RESISTANCE

Make this test to determine if the ballast resistor in the ignition primary circuit has the correct resistance.



1. Set VOLT-OHM Selector to X1.
2. Calibrate meter.
3. Disconnect the leads from one or both ends of the ballast resistor.
4. Connect one test lead to either end of ballast resistor.
5. Connect the other test lead to other end of ballast resistor.
6. Read meter.

GOOD Resistance is within specifications.

BAD Higher or lower resistance than specified indicates the ballast resistor has the wrong value and will affect ignition system performance.

IGNITION COIL TESTER

The Ignition Coil Tester is used to test all types of ignition coils for shorts, opens, bad insulation and output. In addition, the tester may be used as a high voltage source to check out the insulation of components used in the secondary circuit.

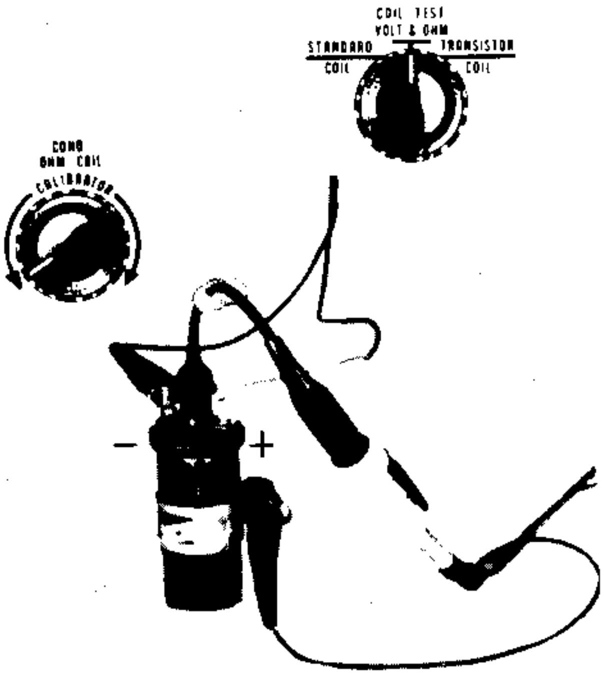
The Ignition Coil Tester uses the black twin-flex leads to supply power to the coil. The COND.-OHM-COIL CALIBRATOR knob is used to adjust the voltage. The COIL TEST selector, the Sun Scope and its secondary pattern pickup leads are used to observe and measure the coil output.

DETAIL TEST

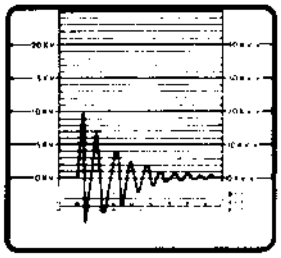
Conventional or transistor coils.

Make this test to determine if the ignition coil is the source of a problem indicated on the Scope.

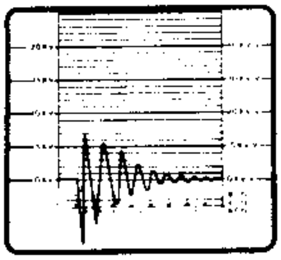
1. Measure the primary and secondary coil winding resistance with the ohmmeter and compare to specifications. If GOOD, continue to step 2. If BAD, the coil should not be used for this application.
2. Connect the black twin-flex leads to the primary coil terminals, RED to +, BLACK to -.
3. Clamp-on pattern pick-up: Insert the coil's high tension lead or a similar high tension type lead into the coil tower and clamp the pattern pick-up around the lead.
   Plug-in type pick-up: Put the pattern pick-up lead into the coil tower. Connect the black lead from the pattern pick-up to ground (coil holder or an engine ground if testing in the vehicle).
4. Follow the Sun Scope control setting procedure to obtain a display pattern of a secondary circuit. Set pattern height to 40KV.
5. Turn OHM-COND-CALIBRATOR knob full counter-clockwise.



GOOD

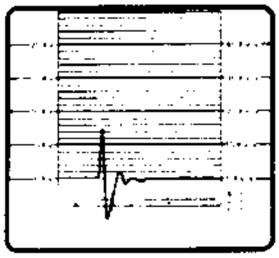


BAD



REVERSED POLARITY – First spike goes downward.

BAD



SHORTED – waveform does not reach 20 KV or has only a few oscillations, is jittery, or with a distorted shape.

6. Turn coil test selector to STANDARD COIL for conventional ignition systems or to TRANSISTOR COIL for transistor ignition systems.

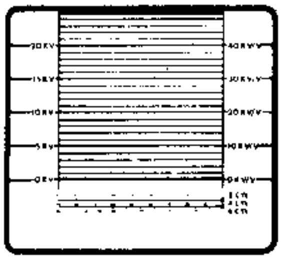
7. Slowly turn CALIBRATOR clockwise until the highest part of the trace reaches 20 KV. Observe pattern.

MAGNETO COILS

Make this test to determine if the magneto's coil is the source of problems indicated on the Scope.

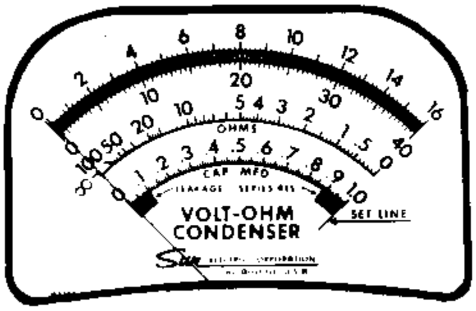
1. Magneto type coils are tested the same way as conventional coils except, do not exceed the manufacturers rated output or 20 KV, if not specified, during testing.

BAD



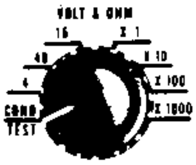
OPEN – Trace is a straight line.

CONDENSER TESTER



The Condenser Tester is used to test the condensers used in various parts of an automobile's electric circuit. Condensers which may be tested include the ignition condenser found in the distributor and noise suppression condensers found on the generator, alternator or accessory motors.

Condensers are tested for three conditions. Series Resistance the amount of resistance in the pigtail lead and the ground circuit, Leakage the amount of current that can leak from one side of the condenser to the other and Capacity, the amount of energy in microfarads that the condenser can store.



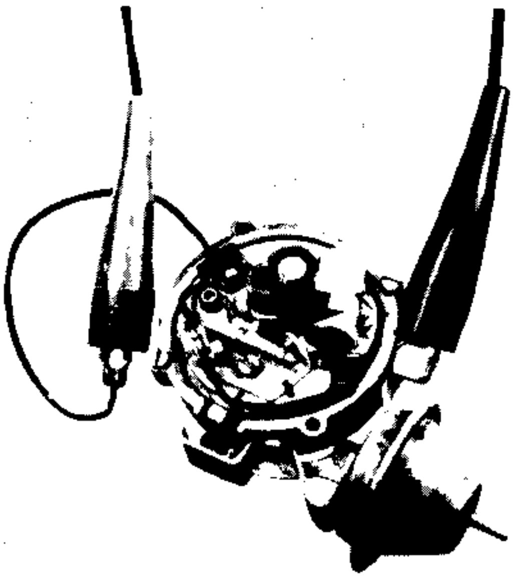
The condenser tester uses the twin-flex cable. The condenser to be tested should be electrically removed from the circuit by opening the ignition contact points or breaking the connection at the pigtail lead.

The VOLT & OHM selector knob is used to select the COND. TEST position.

To calibrate the tester connect the leads together and turn the COND. OHM-COIL CALIBRATOR knob until the meter reads on the SET LINE with the VOLT & OHM knob in the COND. TEST position.

IGNITION CONDENSER

POINTS OPEN



Make this test to determine if the condenser is the cause of problems indicated on the scope in the maximum coil output test, in the intermediate section test or during point closing or opening tests. Also test to be sure a new condenser meets all operational requirements before installation in the distributor.

1. Disconnect the coil to distributor primary lead at the coil.
2. Bump engine over until contact points are open.
3. Connect one test lead to the end of the primary lead and the other to any good engine ground.

   NOTE: If condenser fails any one of these tests. STOP. Do not test any further. Replace the condenser.
4. Test for Series Resistance:
   a. The CONDENSER TEST knob is spring loaded in the SERIES RESISTANCE position.

b. The meter should read in the Black Band at the right end of the scale.

c. Move the pigtail leads. If moving the leads causes the meter to read out of the Black Band or move into the Black Band then the leads or ground circuit have excess resistance due to broken wires or poor connections. The distributor lead may be checked by moving the test lead to the end of the condenser pigtail lead and repeating this test.

d. To check if the excessive resistance is in the ground circuit, move the other test lead to the body of the condenser. If the meter now reads in the Black Band, then check for a poorly grounded condenser or distributor body.

5. Test for Leakage

a. Move the CONDENSER TEST knob to LEAKAGE.

b. The meter should now read in the Black Band at the left end of the scale.

c. DO NOT TOUCH THE TEST LEADS OR CONDENSER PIGTAIL WHILE MAKING THIS TEST.

6. Capacity Test

a. Move the CONDENSER TEST knob to CAPACITY.

b. The meter will now read the capacity.

RESULTS GOOD – Condensers that test in the black bands for series resistance and leakage and within specification for capacity.

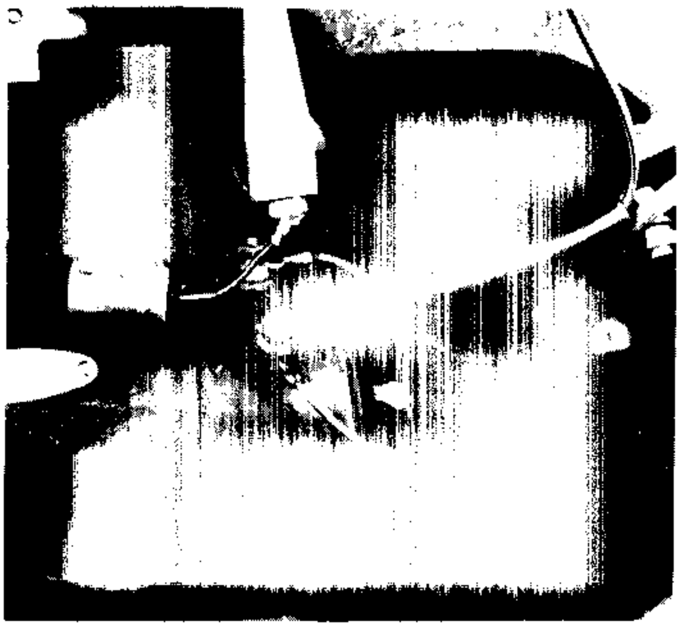
BAD – Condensers that test outside the black band for series resistance, or leakage, or the meter moves when pigtail lead is moved during the series resistance test, or are not within capacity specification should be replaced.

RADIO NOISE SUPPRESSION CONDENSERS

Make this test to determine if the Suppression Condenser is working properly if excessive radio noise is present in the radio or other electronic device.

1. Remove pigtail lead from terminal and test the same way as an ignition condenser.

[illegible]



NAME ________________

ELECTRICAL COMPONENT TESTING QUIZ

1. Voltage is:

   A. Electrical flow
   B. Electrical pressure
   C. Electrical resistance
   D. Electrical capacity

2. Current is:

   A. Electrical flow
   B. Electrical pressure
   C. Electrical resistance
   D. Electrical capacity

3. An ohm is a measure of:

   A. Electrical flow
   B. Electrical pressure
   C. Electrical resistance
   D. Electrical capacity

4. Microfarad is a measure of:

   A. Electrical flow
   B. Electrical pressure
   C. Electrical resistance
   D. Electrical capacity

5. The ignition coil steps up voltage from 6 or 12 volts to as much as:

   A. 1,000 to 5,000
   B. 5,000 to 10,000
   C. 20,000 to 30,000
   D. 45,000 to 48,000

6. Which is part of the secondary ignition circuit:

   A. Condenser
   B. Breaker points
   C. Battery
   D. Distributor rotor

7. Which is part of the primary ignition circuit:

   A. Breaker points
   B. Distributor cap
   C. Distributor rotor
   D. Spark plugs

8. When using the ohmmeter, the item being checked:

   A. Should be electrically removed from the circuit
   B. Need not be removed from the circuit
   C. May be checked while the circuit is live
   D. No special precautions are necessary

9. Mechanic A says ignition coils may be tested either on or off the engine, but condensers must be tested on the engine.

   Mechanic B says both ignition coils and condensers may be tested either on or off the engine.

   A. A only
   B. B only
   C. Both A and B
   D. Neither A or B

10. During the coil output test, a good or bad coil is indicated:

   A. By the voltmeter
   B. By the ammeter
   C. By the voltmeter and scope
   D. By the waveform on the scope

INTRODUCTION TO THE SUN SCOPE

The Sun Scope is a voltmeter. The line seen is voltage, represented on a TV like screen instead of a meter. The scope shows the voltage and how it changes during a period of time.

The Sun Scope has the advantage of being able to show very rapid changes of voltage. Changes that occur so rapidly that a regular meter couldn't move, to show these voltage changes. An example of this type of rapid change occurs when a spark plug fires. The voltage changes from zero to 10,000 volts and back to zero in the time it takes the engine to turn enough to open and close the distributor points just once.

The shape of the line on the screen tells us what's happening in the ignition system. The scope shows the secondary ignition circuit at work. It shows how the coil, coil wire, distributor cap, rotor, plug wires, and the spark plugs work together as each cylinder of the engine fires. The shape of the line tells us how much voltage it takes to fire the plug, how resistance in the secondary circuit is affecting the arcing of the plug, how the coil and condenser are working and the condition of the contact points when they close and open to fire the next spark plug.

We'll look for the shape or pattern that is produced by a properly operating ignition system. Patterns that are different indicate problems in the ignition system. Problems in the primary ignition circuit, the contact points, condenser, coil and the connecting wires, affect the secondary ignition circuit pattern. A scope pattern that's different indicates a problem. The part of the trace that is affected indicates which components aren't working right.

Learning how to use the scope is then:

1. Learning what a good ignition system pattern looks like.
2. Knowing what components affect each area of the trace.

The secondary ignition pattern from a properly operating ignition system appears like Figure 1. This shows what's happening in just one cylinder of an engine.

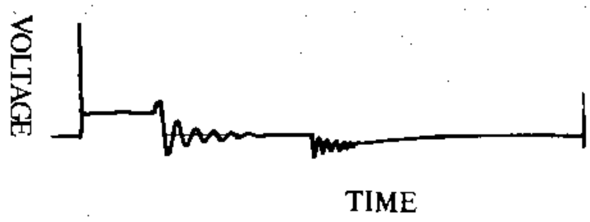


Figure 1

INTRODUCTION TO THE SCOPE

The pattern may be divided into three parts (Figure 2): The firing section, the intermediate section and the dwell section. During scope testing we will look at each of these sections and compare them to a good pattern. The following information is an overview of the pattern we will be seeing.

The firing section consists of the firing line, the voltage required to fire the spark plug, and the spark line, the changes in voltage that occur as the plug arcs. At the end of the spark line the arcing at the plug stops.

The intermediate section which follows is a series of wavy lines (oscillations) that diminish in size. These lines show the coil and condenser using up the remaining energy left in the ignition circuit after the arcing has stopped.

When the ignition points close, to start the dwell section, the pattern goes down and is followed by oscillations which diminish in size. At the end of the dwell period the pattern turns sharply upwards.

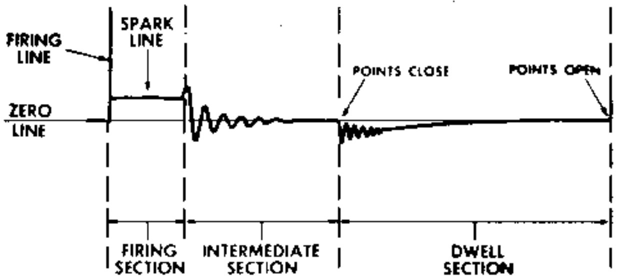
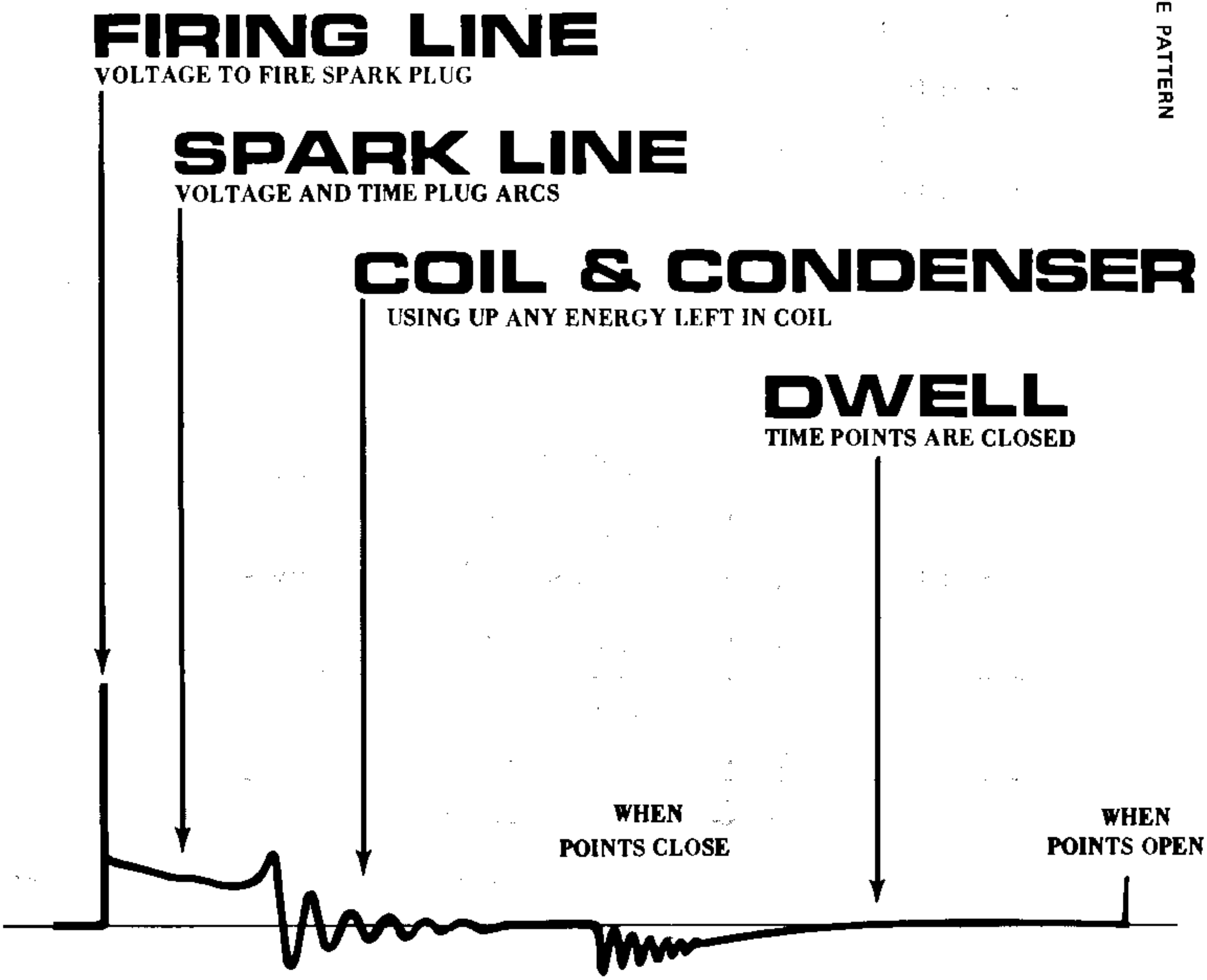


Figure 2

EVALUATION OF BAD TRACES

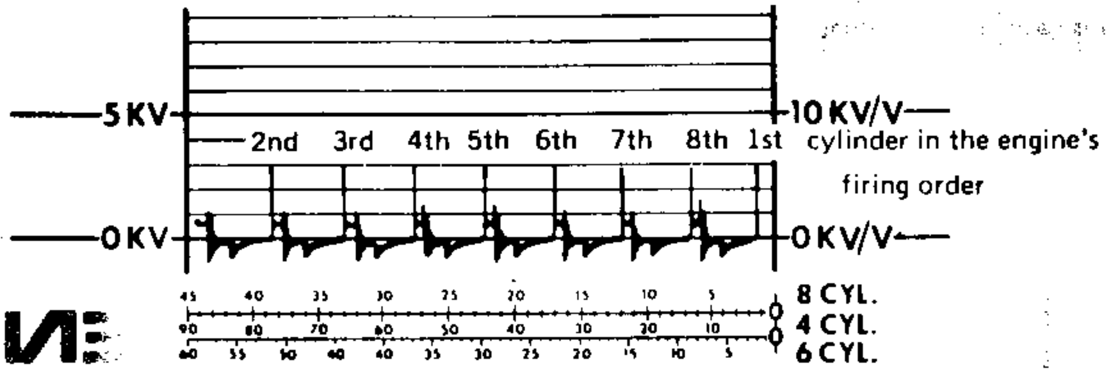
Problems with spark plugs, wires, rotor or engine conditions will be seen in the firing sections. Coil, condenser, or primary circuit problems are found in the intermediate section. The dwell section will show up contact point or condenser problems.



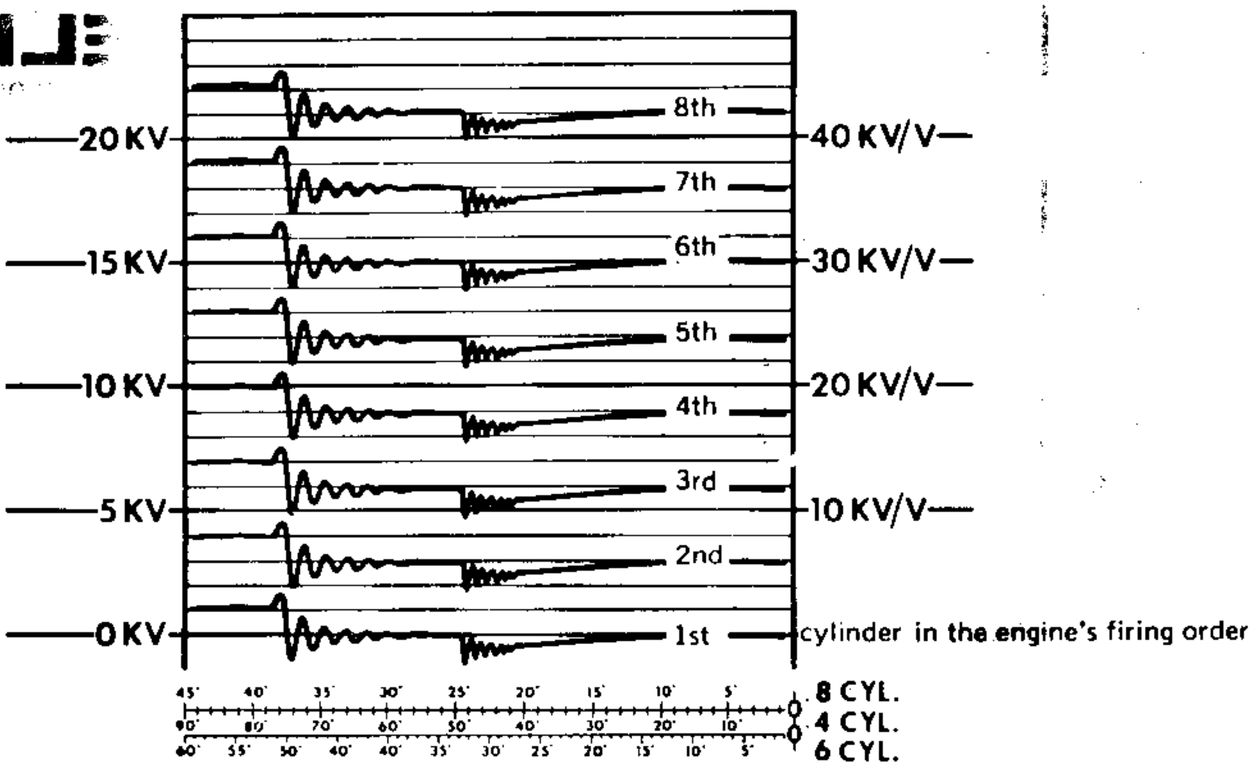
Problems here may be caused by:	Problems here may be caused by:	Problems here may be caused by:	Problems here may be caused by:
Plugs, wires, cap, rotor, or engine condition affecting plug firing.	Defects in coil condenser, or primary circuit.	Poor contact, dirty, burned or misaligned points and weak point tension.	Pitted points or arcing from poor condenser action.

SCOPE PATTERN

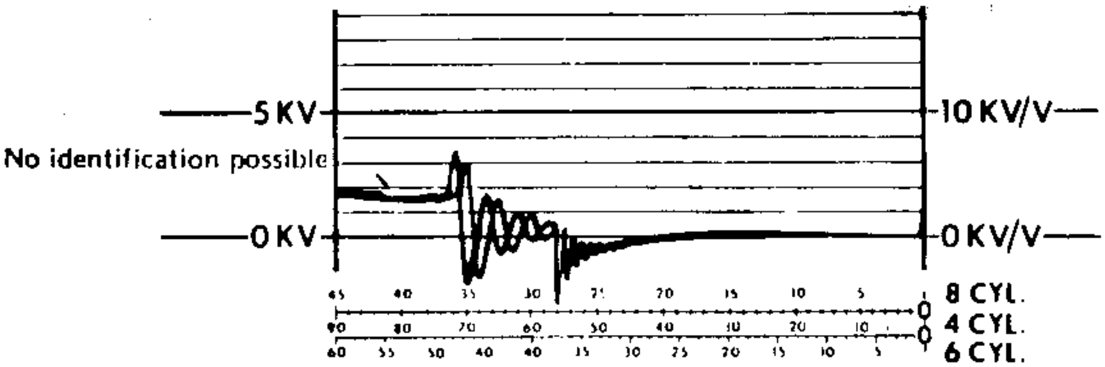
Method of identifying cylinders on Sun scope traces



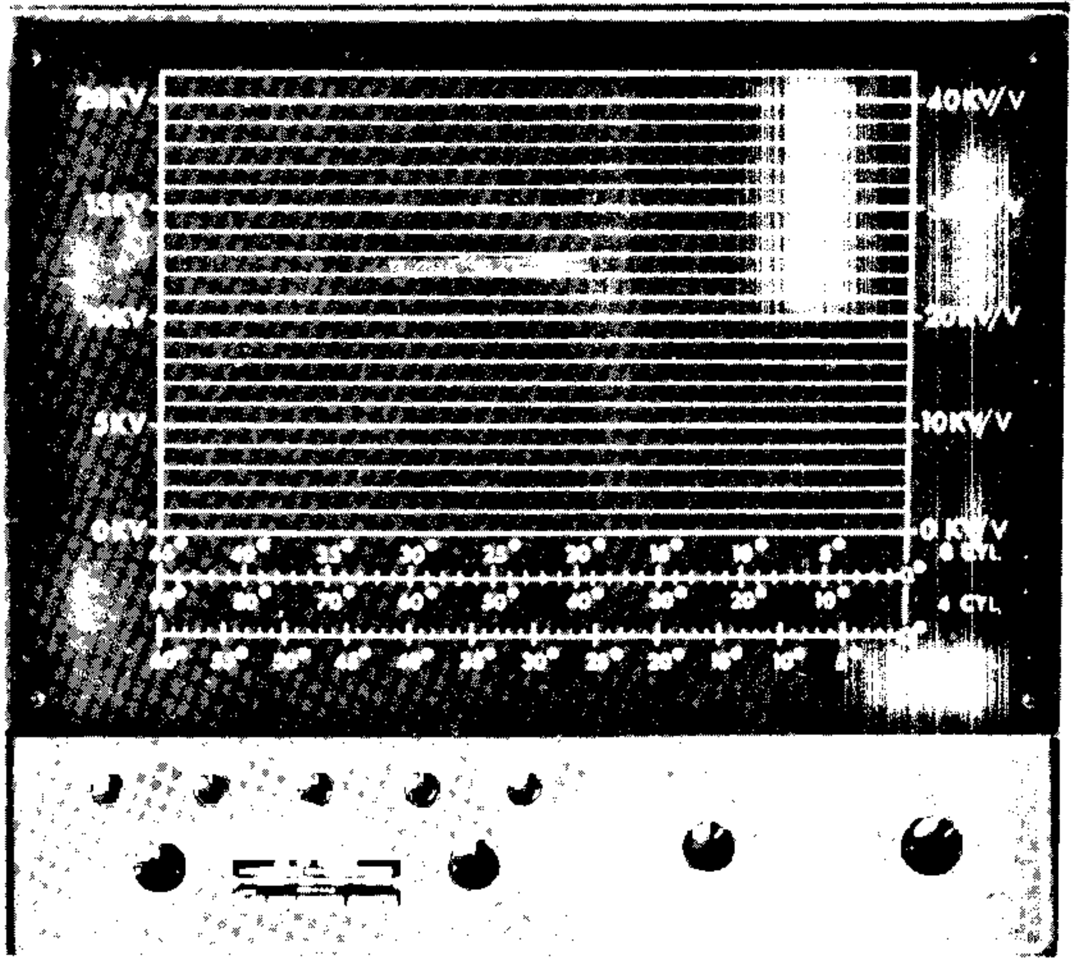
DISPLAY



RASTER



SUPERIMPOSED



SUN SCOPE CONTROLS

SS-400

The controls of the Sun Scope are used to select what circuit is to be seen, how the trace will be shown on the screen, and the size of the trace. The shape of the trace is controlled only by the changes in the voltage in the circuit not by any of the controls. During most scope testing only two controls are used. The CIRCUIT SELECTOR which determines which circuit is to be seen and the PATTERN SELECTOR which determines how the pattern is to be shown. The remaining controls are adjusted only when first setting up the scope.

BASIC SETTING, MODEL SS-400

Follow these steps to obtain a trace of the secondary ignition circuit.

1. Turn the TESTER A.C. switch on.
2. Turn the PATTERN SELECTOR knob to the DISPLAY position. (The Pilot light should be on).
3. Turn the CIRCUIT SELECTOR knob to the SECONDARY position.
4. Turn the SECONDARY PATTERN HEIGHT knob to the 40-KV position.
5. Turn the BRIGHTNESS CONTROL knob until a bright pattern line appears.
6. Turn the VERTICAL CONTROL knob until the pattern is on the 0-KV line of the scope.
7. Turn HORIZONTAL CONTROL knob until left end of the pattern is on the left margin line.
8. Turn the PATTERN LENGTH CONTROL knob until the right end of the pattern is on the right margin line.
9. Readjust the HORIZONTAL CONTROL knob and the PATTERN LENGTH CONTROL knob as needed after the engine is started.

Follow these steps to obtain a trace of the primary ignition circuit.

1. Turn the PRIMARY PATTERN HEIGHT knob to the 400 V position.
2. Turn the CIRCUIT SELECTOR knob to the PRIMARY position.

FUNCTION OF THE CONTROLS [redacted]

The PATTERN SELECTOR knob changes the way the ignition system operation is shown on the screen. There are three ways to look at the ignition system on a Sun Scope. In the DISPLAY position, each cylinder follows the other across the screen according to the firing order. In the RASTER position, the cylinders are placed one above the other for easier viewing. In the SUPERIMPOSED position, the cylinders are placed one in front of the other, so that anything unusual can be seen.

The CIRCUIT SELECTOR knob lets you see primary and secondary ignition operation. Two primary positions are provided for positive and negative ground systems.

The SECONDARY PATTERN HEIGHT knob controls the size of the secondary pattern. When in the 40-KV position you read the scale on the right side of the screen. When in the 20-KV position read the scale on the left side of the screen. Remember you are reading Kilovolts or thousands of volts. KV means 1000-Volts.

The BRIGHTNESS CONTROL knob adjusts the intensity of the pattern.

The VERTICAL CONTROL knob raises and lowers the pattern on the screen.

The HORIZONTAL CONTROL adjusts the horizontal position of the pattern.

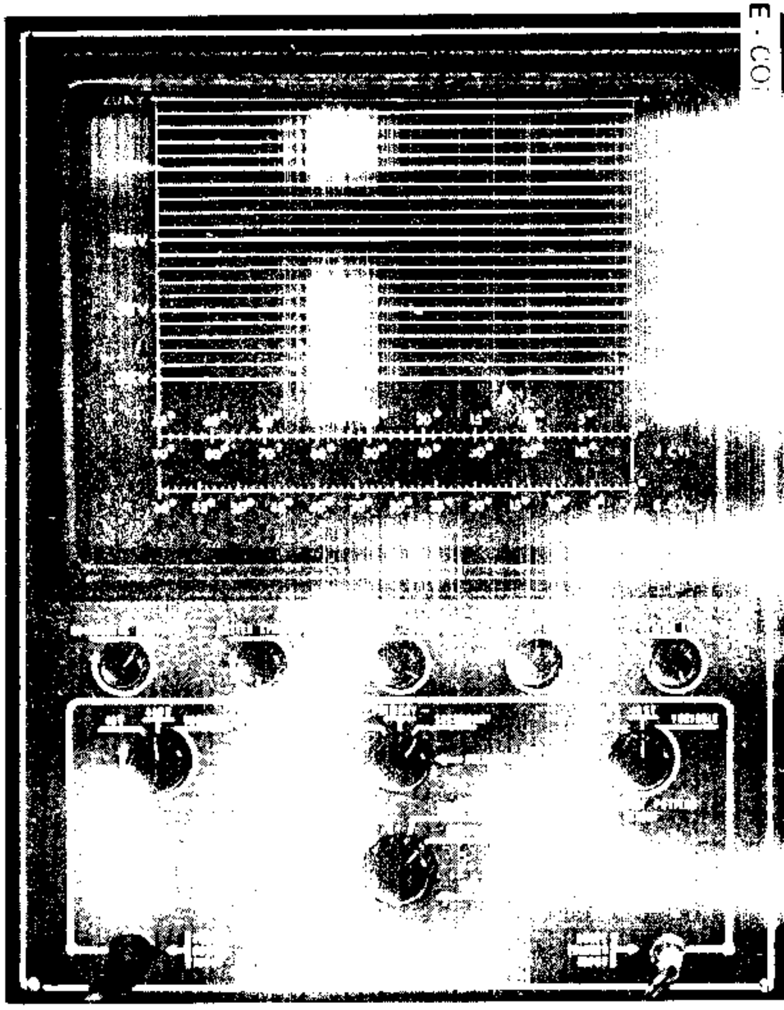
The PATTERN LENGTH knob adjusts the horizontal length of the pattern.

The PRIMARY PATTERN HEIGHT knob lets you control the size of the primary pattern. When in the 400-VOLT position, you read the scale on the right side of the screen. Since the scale only goes from 0 to 40, you have to add a zero when reading this scale. When in the 40-VOLT position, you read the number directly.

The RASTER SPACING knob adjusts the spacing between individual cylinder patterns when the Pattern Selector is in Raster position.

SUN SCOPE CONTROLS
MODELS SS-100 and SS-110

The controls of the Sun Scope are used to select what circuit is to be seen, how the trace will be shown on the screen, and the size of the trace. The shape of the trace is controlled only by the changes in the voltage in the circuit not by any of the controls. During most scope testing only two controls are used. The CIRCUIT SELECTOR which determines which circuit is to be seen and the PATTERN SELECTOR which determines how the pattern is to be shown. The remaining controls are adjusted only when first setting up the scope.



BASIC SETTING

Follow these steps to obtain a trace of the secondary ignition circuit.

1. Turn the TESTER A.C. switch on.
2. Turn the PATTERN SELECTOR knob to the DISPLAY position. (The Pilot light should be on).
3. Turn the CIRCUIT SELECTOR knob to the SECONDARY position.
4. Turn the SECONDARY PATTERN HEIGHT knob to the 40-KV position.
5. Turn the BRIGHTNESS CONTROL knob until a bright pattern line appears.
6. Turn the VERTICAL CONTROL knob until the pattern is on the 0-KV line of the scope.
7. Turn HORIZONTAL CONTROL knob until left end of the pattern is on the left margin line.
8. Turn the PATTERN LENGTH CONTROL knob until the right end of the pattern is on the right margin line.
9. Readjust the HORIZONTAL CONTROL knob and the PATTERN LENGTH CONTROL knob as needed after the engine is started.

Follow these steps to obtain a trace of the primary ignition circuit.

1. Turn the PRIMARY PATTERN HEIGHT knob to the 400 V position.
2. Turn the CIRCUIT SELECTOR knob to the PRIMARY position.

FUNCTION OF THE CONTROLS

The PATTERN SELECTOR knob changes the way the ignition system operation is shown on the screen. There are three ways to look at the ignition system on a Sun Scope. In the DISPLAY position, each cylinder follows the other across the screen according to the firing order. In the RASTER position, the cylinders are placed one above the other for easier viewing. In the SUPERIMPOSED position, the cylinders are placed one in front of the other, so that anything unusual can be seen.

The CIRCUIT SELECTOR knob lets you see primary and secondary ignition operation. Two primary positions are provided for positive and negative ground systems.

The SECONDARY PATTERN HEIGHT knob controls the size of the secondary pattern. When in the 40-KV position you read the scale on the right side of the screen. When in the 20-KV position read the scale on the left side of the screen. Remember you are reading Kilovolts or thousands of volts. KV means 1000-Volts.

The BRIGHTNESS CONTROL knob adjusts the intensity of the pattern.

The VERTICAL CONTROL knob raises and lowers the pattern on the screen.

The HORIZONTAL CONTROL adjusts the horizontal position of the pattern.

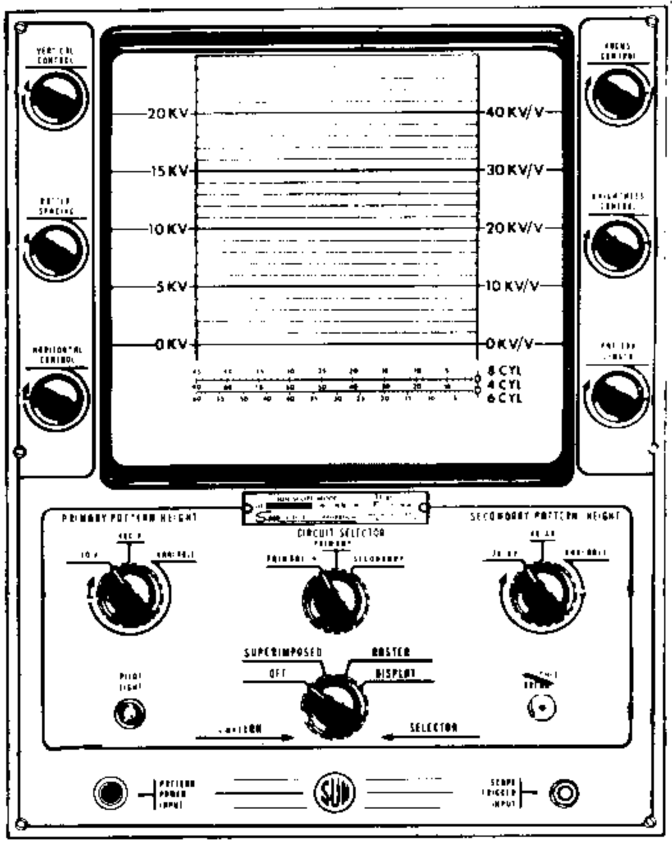
The PATTERN LENGTH knob adjusts the horizontal length of the pattern.

The PRIMARY PATTERN HEIGHT knob lets you control the size of the primary pattern. When in the 400-VOLT position, you read the scale on the right side of the screen. Since the scale only goes from 0 to 40, you have to add a zero when reading this scale. When in the 40-VOLT position, you read the number directly.

The RASTER SPACING knob adjusts the spacing between individual cylinder patterns when the Pattern Selector is in Raster position.

SUN SCOPE CONTROLS
MODELS SS-87 SS-95

The controls of the Sun Scope are used to select what circuit is to be seen, how the trace will be shown on the screen, and the size of the trace. The shape of the trace is controlled only by the changes in the voltage in the circuit and not by any of the controls. During most scope testing only two controls are used. The CIRCUIT SELECTOR which determines which circuit is to be seen and the PATTERN SELECTOR which determines how the pattern is to be shown. The remaining controls are adjusted only when first setting up the scope.



BASIC SETTINGS

Follow these steps to obtain a trace of the secondary ignition circuit.

1. Turn the TESTER A.C. switch on.
2. Turn the PATTERN SELECTOR knob to the display position. (The Pilot light should be on).
3. Turn the CIRCUIT SELECTOR knob to the secondary position.
4. Turn the SECONDARY PATTERN HEIGHT knob to the 40-KV position.
5. Turn the BRIGHTNESS CONTROL knob full clockwise.
6. Turn the HORIZONTAL CONTROL knob full clockwise.
7. Turn the VERTICAL CONTROL knob until a bright line appears.
8. Turn the FOCUS CONTROL until the trace is sharp.
9. Turn the VERTICAL CONTROL knob until the pattern is on the 0-KV line of the scope.
10. Turn the HORIZONTAL CONTROL knob until until the left end of the pattern is on the left margin line.
11. Turn the PATTERN LENGTH CONTROL knob until the right end of the pattern is on the right margin line.
12. Readjust the HORIZONTAL CONTROL knob and the PATTERN LENGTH CONTROL knob as needed after the engine is started.
13. Readjust the BRIGHTNESS CONTROL knob to obtain desired brilliance.

Follow these steps to obtain a trace of the primary ignition circuit.

1. Turn the PRIMARY PATTERN HEIGHT knob to the 400V position.
2. Turn the CIRCUIT SELECTOR knob to the PRIMARY position.

FUNCTION OF THE CONTROLS

The PATTERN SELECTOR knob changes the way the ignition system operation is shown on the screen. There are three ways to look at the ignition system on a Sun Scope. In the DISPLAY position, each cylinder follows the other across the screen according to the firing order. In the RASTER position, the cylinders are placed one above the other for easier viewing. In the SUPERIMPOSED position, the cylinders are placed one in front of the other, so that anything unusual can be seen.

The CIRCUIT SELECTOR knob lets you see primary and secondary ignition operation. Two primary positions are provided for positive and negative ground systems.

The SECONDARY PATTERN HEIGHT knob controls the size of the secondary pattern. When in the 40-KV position you read the scale on the right side of the screen. When in the 20-KV position read the scale on the left side of the screen. Remember you are reading Kilovolts or thousands of volts. KV means 1000-Volts.

The BRIGHTNESS CONTROL knob adjusts the intensity of the pattern.

The VERTICAL CONTROL knob raises and lowers the pattern on the screen.

The HORIZONTAL CONTROL adjusts the horizontal position of the pattern.

The PATTERN LENGTH knob adjusts the horizontal length of the pattern.

The PRIMARY PATTERN HEIGHT knob lets you control the size of the primary pattern. When in the 400-VOLT position, you read the scale on the right side of the screen. Since the scale only goes from 0 to 40, you have to add a zero when reading this scale. When in the 40-VOLT position, you read the number directly.

The RASTER SPACING knob adjusts the spacing between individual cylinder patterns when the Pattern Selector is in Raster position.

The FOCUS CONTROL knob adjusts the sharpness of the trace.

SUN SCOPE HOOK UP

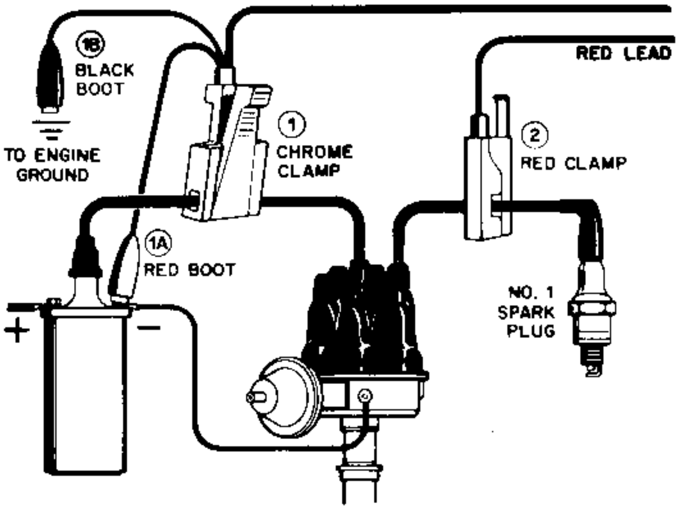
The Sun scope uses only two cables to connect the scope to the engine's ignition system.

The cable is the Pattern pickup and is connected to the primary ignition circuit at the coil's distributor terminal and to the secondary circuit at the coil's high tension tower. The trigger lead is used to trigger the scope so the pattern follows the firing order and is connected to the NO. 1 Spark plug.

BASIC HOOK UP

Follow these steps to obtain a trace of both the secondary and primary ignition circuits on conventional ignition systems.

TESTERS WITH CLAMP-ON PICKUPS

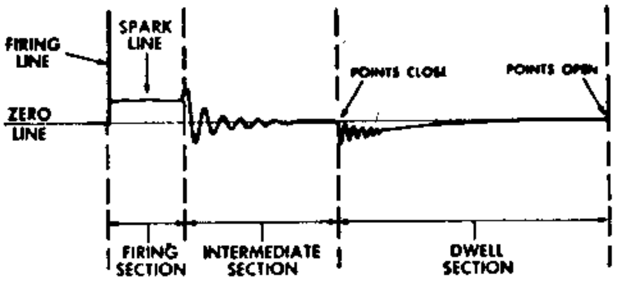


1. Clamp the Pattern Pickup around the coil's high tension lead:
   - a. For cranking tests, remove the coil high tension lead from the distributor center tower. Position lead so it does not touch ground or the case of Pattern Pickup.
   - b. For running tests, do not remove the coil high tension lead.
2. Connect the Red clip to the coil's distributor terminal.
3. Connect the Black clip to a good engine ground.
4. Clamp the Trigger Pickup around the NO. 1 spark plug lead near the distributor cap. If another cylinder is used for timing, clamp the lead around that cylinder's spark plug lead.

NOTE: If erratic tachometer operation and/or the scope mistriggers, check that the Trigger Pickup Clamp surfaces are clean and firmly closed. If the problem persists, try the Trigger Pickup on another cylinder. If the problem is corrected, then replace NO. 1 spark plug lead, move Trigger Pickup back and continue test.

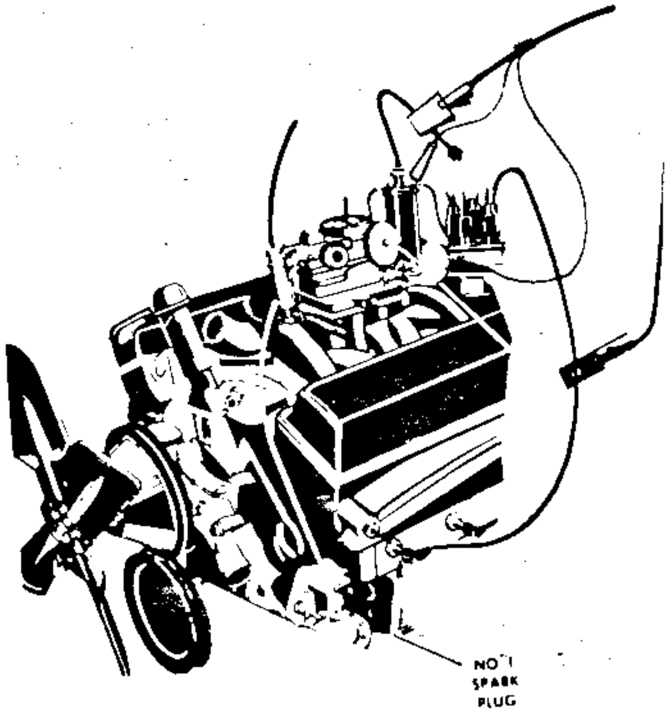
SUN SCOPE SECONDARY IGNITION SYSTEM TESTING

The scope measures the voltage in the secondary ignition circuit (spark plugs, plug wires, coil wire, cap, rotor). This voltage is then shown on the scope as a voltage and time picture. The scope shows the voltage required to fire the spark plugs, the effect of secondary circuit resistance on the arcing of the plugs, the action of the coil and condenser and the condition of the contact points as they close and open. In addition, the scope can be used to measure the maximum voltage the ignition system can develop, the insulation of the secondary circuit and the accuracy at which the ignition system fires each plug with respect to the mechanical operation of the engine. The scope also shows problems in the primary circuit that affect the secondary circuit.



Testing the secondary circuit requires the use of the high voltage pattern pickup and the black ground lead. Both are part of the Pattern Pickup Cable. The trigger lead is connected to the NO. 1 cylinder spark plug lead.

The CIRCUIT SELECTOR is placed in SECONDARY. The PATTERN HEIGHT CONTROL should be placed in the 40 KV position and the PATTERN SELECTOR in DISPLAY.



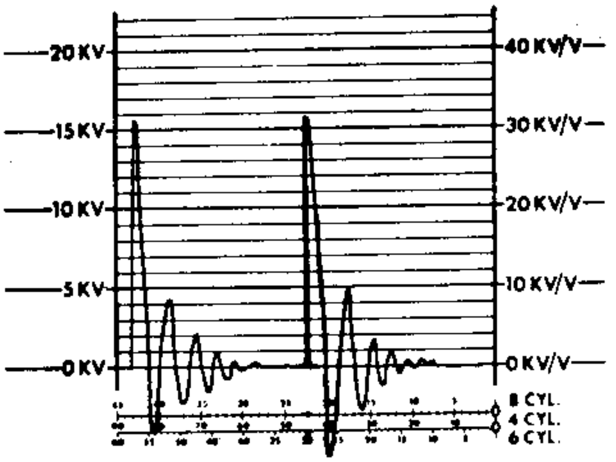
CRANKING COIL OUTPUT

Make this test to determine if the ignition system can produce sufficient voltage to start the engine.

1. Clamp pickup around High Tension wire.
2. Remove the coil's high tension wire from the distributor center tower and position clear of ground as illustrated.
3. Crank the engine and record height of highest line on the scope's screen (40 KV scale).

   GOOD Highest part of trace exceeds 20 KV.

   BAD If the trace does not exceed 20 KV check the dwell, the voltage applied to coil, check the coil with the coil tester and the condenser using the condenser tester.



4. Reconnect the coil high tension lead; start the engine and allow it to warm up; and set the engine speed to approximately 1000 RPM.

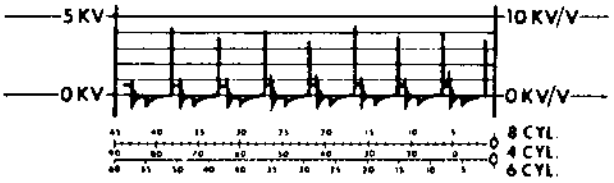
COIL POLARITY

Make this test to determine if the ignition system has the correct polarity.

5. Look at the firing lines.

   GOOD Firing lines go upwards.

   BAD If the pattern is upside down, check if primary leads are connected correctly or if the battery is installed wrong. The coil's polarity may be checked with the coil tester.



SPARK PLUG FIRING VOLTAGE

Make this test to determine if any problem exists in the spark plugs, plug wires, distributor, or in the engine, which affects the voltage required to fire the spark plugs.

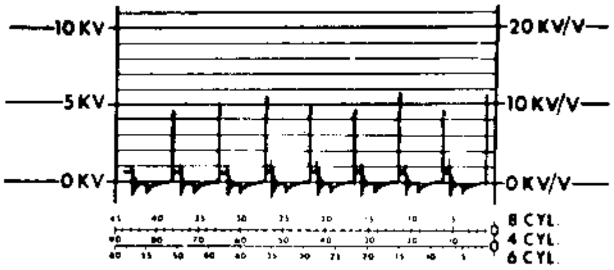
6. Record the height of the highest and lowest firing lines. Subtract the lowest from the highest.

   GOOD Maximum difference is less than 3 KV. No firing lines are above 15 KV or below 5 KV.

   BAD High firing voltages are usually due to excessive plug gap, lean fuel mixtures, broken or damaged spark plug wires, excessive rotor gap or poor connections in the secondary circuit. If all the firing voltages are high, look for problems in the coil wire, center distributor tower or rotor.

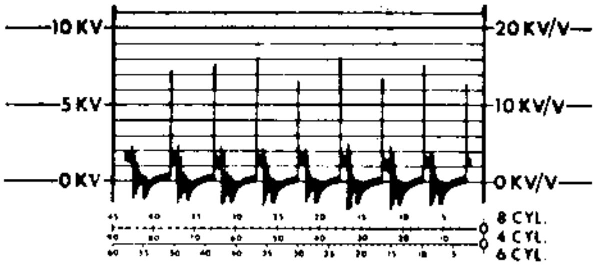
   Low firing voltages are usually due to fouled plugs or rich fuel mixtures.

   Uneven firing voltage, look for a cocked distributor cap or unbalanced fuel mixtures.



SPARK PLUGS UNDER LOAD

Make this test to determine the voltage necessary to fire the spark plugs when the engine is under load.



7. Return the engine to idle RPM.

8. Yank the throttle open briefly. Record the height of the highest and lowest firing lines. Subtract the lowest from the highest.

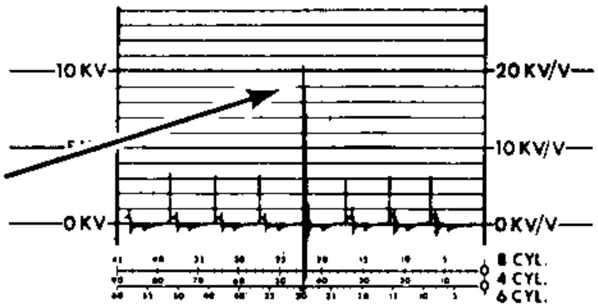
   GOOD Maximum difference between cylinders is less than 3 KV. The firing voltages of all cylinders increase slightly.

   BAD If the firing voltage increases excessively, look for wide plug gap or poor spark plug electrode condition. If the firing voltages drop, look for plug fouling.

9. Return engine speed to approximately 1000 RPM.

AVAILABLE COIL VOLTATE

Make this test to determine if the ignition system will produce enough to fire the spark plugs under all operating conditions.



10. Pull off any spark plug wire and hold it away from ground. Record height of trace for that cylinder.

    GOOD Highest part of trace exceeds 20 KV.

    BAD If the output is low, check dwell; check for poor secondary circuit insulation; or check for excessive resistance in the primary circuit by measuring primary current with an ammeter. Check for a defective coil with the coil tester, for a defective condenser with the condenser tester.

SECONDARY CIRCUIT INSULATION

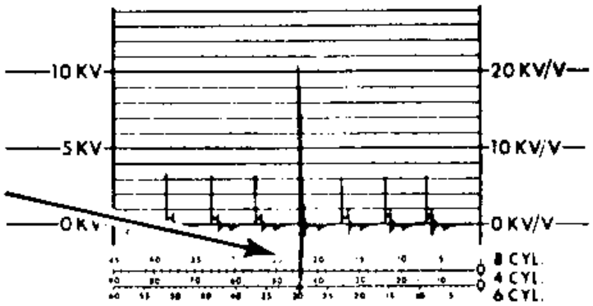
Make this test to determine if the insulation of the secondary circuit (cap, wires, plug or coil wire) will break down under operating conditions.

11. While holding the spark plug lead away from ground, note the first downward spike of the trace for that cylinder.

    GOOD Downwards spike appears constantly.

    BAD No downward spike or an intermittent spike indicates an insulation breakdown in the secondary circuit.

12. Move the Pattern Selector to RASTER.



SECONDARY CIRCUIT CONDITION

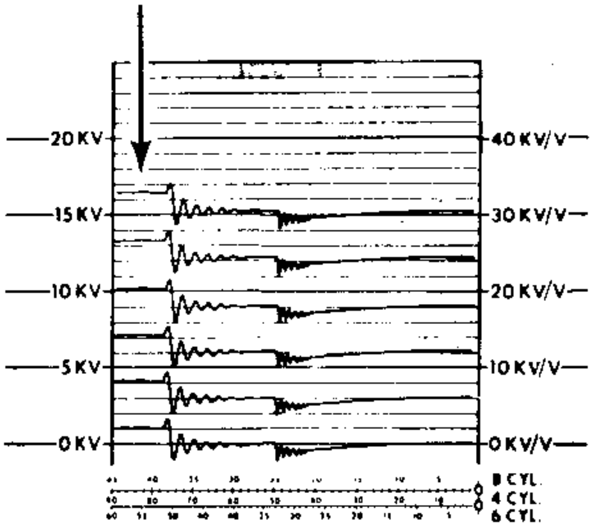
Make this test to determine if there is excessive resistance in the secondary circuit.

13. Look at the spark lines of each cylinder.

    GOOD Spark lines are nearly level and about the same length.

    BAD Spark lines that slope excessively downwards indicate excessive secondary resistance in the spark plug, plug wires, distributor cap or rotor. Spark lines that are excessively long indicate a fouled plug or shorted secondary circuit.

    If all cylinders are equally bad look for problem in the common components, rotor, center tower of the distributor cap, the coil wire, or coil tower.



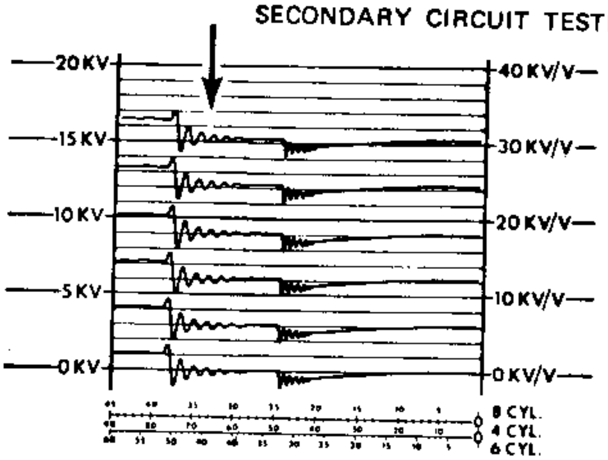
COIL AND CONDENSER CONDITION

Make this test to determine if the coil and condenser are working properly.

14. Look at the coil and condenser section.

    GOOD Several diminishing oscillations.

    BAD Only one oscillation or misformed oscillations indicate a coil or condenser problem. Test the coil with the coil tester and the condenser with the condenser tester.



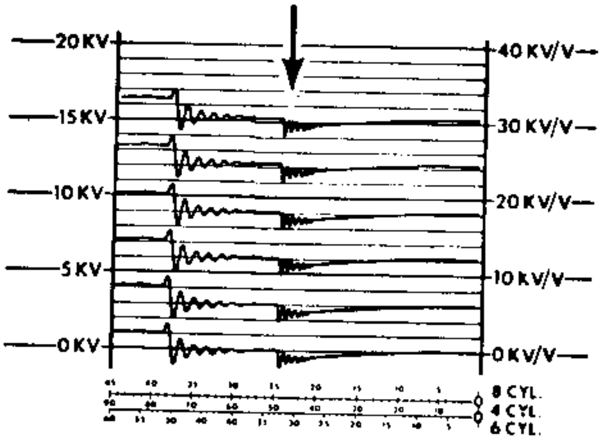
POINT CLOSE

Make this test to determine if the ignition contact points are closing properly without arcing due to dirty, misaligned or pitted points or bouncing due to incorrect point spring tension.

15. Look at the point close.

    GOOD A short downward line followed by diminishing oscillations.

    BAD No oscillations or unusual upward spike that appears during the oscillations indicate point problems. Visually inspect the contact surface and test the point spring tension.



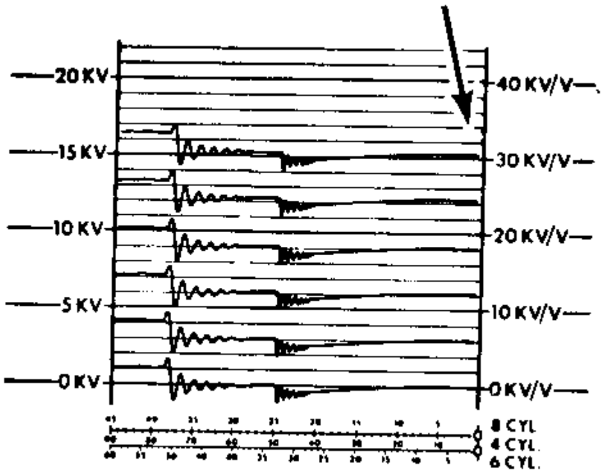
POINT OPEN

Make this test to determine if the ignition contact points are opening properly without arcing due to dirty, pitted surfaces or improper condenser action.

16. Look at the point open.

    GOOD Clean, sharp upward turning of the trace.

    BAD Hash or a step in the trace where it turns upward indicates the points are dirty or pitted or the condenser is not working properly. Visually inspect the points and test the condenser with the condenser tester.



17. Move the Pattern Selector to Superimposed.

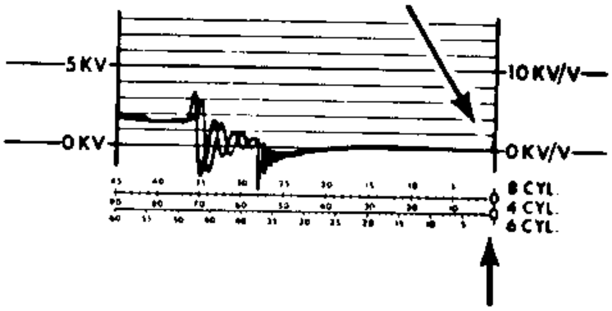
CAM LOBE ACCURACY (Cylinder Timing Accuracy)

Make this test to determine if distributor cam lobe or distributor drive problems are affecting the time at which each cylinder fires.

18. Look at the point open.

    GOOD Point openings with 2 degrees of each other.

    BAD More than 2 degrees between point openings indicates distributor or distributor drive problems. Remove the distributor and test in a distributor testing machine.



NAME ____________________
DATE ____________________

SCOPE TESTING WORKSHEET #1

	GOOD	BAD	GOOD	BAD	GOOD	BAD
1. CRANKING COIL OUTPUT (over 20 KV)	☐	☐	☐	☐	☐	☐
2. COIL POLARITY (pattern right side up)	☐	☐	☐	☐	☐	☐
3. SPARK PLUG FIRING VOLTAGE (maximum difference 3KV, firing lines between 5 and 15 KV high)	☐	☐	☐	☐	☐	☐
4. SPARK PLUGS UNDER LOAD (maximum difference between cylinders 3KV a slight increase in height on all cylinders)	☐	☐	☐	☐	☐	☐
5. AVAILABLE COIL VOLTAGE (over 20 KV)	☐	☐	☐	☐	☐	☐
6. SECONDARY INSULATION (downward spike)	☐	☐	☐	☐	☐	☐
7. SECONDARY CIRCUIT CONDITION (spark lines nearly level and about the same length)	☐	☐	☐	☐	☐	☐
8. COIL AND CONDENSER (several diminishing oscillations)	☐	☐	☐	☐	☐	☐
9. POINT ACTION						
a. POINT CLOSE (short downward line followed by diminishing oscillations)	☐	☐	☐	☐	☐	☐
b. POINT OPEN (sharp upward turn)	☐	☐	☐	☐	☐	☐
10. CAM LOBE ACCURACY (cylinder timing accuracy) (2° maximum difference at point open and point close)	☐	☐	☐	☐	☐	☐

Name: ______________

SCOPE QUIZ I

1. Mechanic A says a vertical line on the scope screen represents time.

   Mechanic B says a vertical line on the scope screen represents voltage.

   A. A only
   B. B only
   C. Both A and B
   D. Neither A or B

2. Time is indicated on the scope screen

   A. By a slanting line
   B. By a vertical line
   C. By a scale in degrees
   D. By a horizontal line

3. A good ignition system operation shows on the scope screen

   A. As smooth lines between spark line and dwell section
   B. As a straight spark line
   C. As a good scope pattern
   D. As a hump in the dwell section

4. Mechanic A says maximum coil output should be 10,000 volts.

   Mechanic B says maximum coil output should always be at least 20,000 volts.

   A. A only
   B. B only
   C. Both A and B
   D. Neither A or B

5. A faulty distributor point condition can

   A. Not be seen on the scope pattern
   B. Be detected by a slanted spark line
   C. Be detected as a hump in the dwell section
   D. Be seen on the scope pattern

6. On standard point systems, good spark lines have three conditions. These are:

   A. Level, do not start high, and have oscillations
   B. Slant downward, do not start high, and free of oscillations
   C. Level, do not start high, and free of oscillations
   D. Level, start high, and free of oscillations

7. The scope provides a fast and accurate means of

   A. Diagnosing ignition system problems
   B. Quality control checking your work before it goes out the door to help eliminate "comebacks"
   C. Neither A or B
   D. Both A and B

8. Three basic sections of a scope pattern are:

   A. Firing, intermediate and raster
   B. Intermediate, dwell and coil and condenser
   C. Dwell, intermediate and firing
   D. Raster, superimposed and display

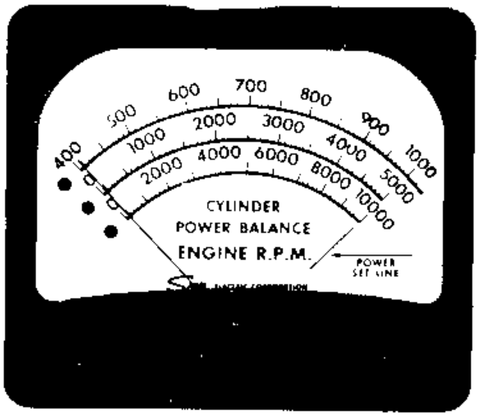
9. Good spark plug firing lines will

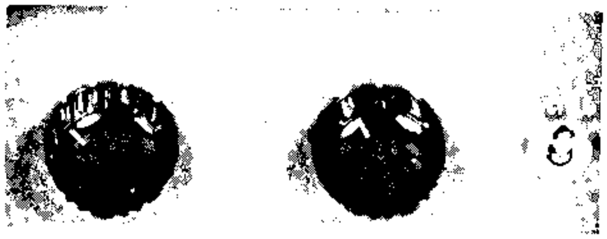
   A. Vary less than 3 KV and be 12-15 KV high
   B. Vary less than 3 KV and be 15-20 KV high
   C. Vary more than 3 KV and be 5-12 KV high
   D. Vary less than 3 KV and be 5-15 KV high

CYLINDER POWER BALANCE
USED ON MODELS EET-1160, 945, 947

The Cylinder Power Balance Tester is used to check all cylinders of an engine, to see that they are producing equal power. This test is used to determine if there are any mechanical, ignition, or fuel system problems which will cause an uneven power output from cylinder to cylinder.

This tester uses the CYLINDER POWER BALANCE push-buttons and the Tachometer.

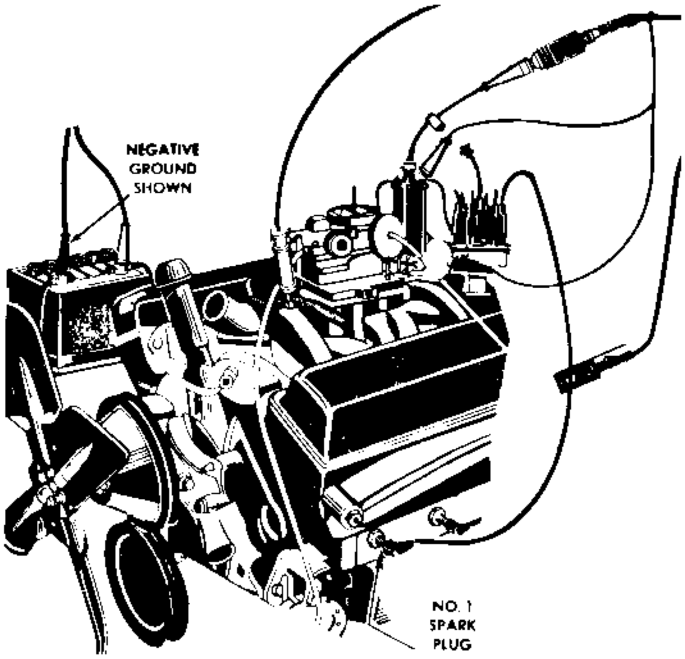




POWER BALANCE

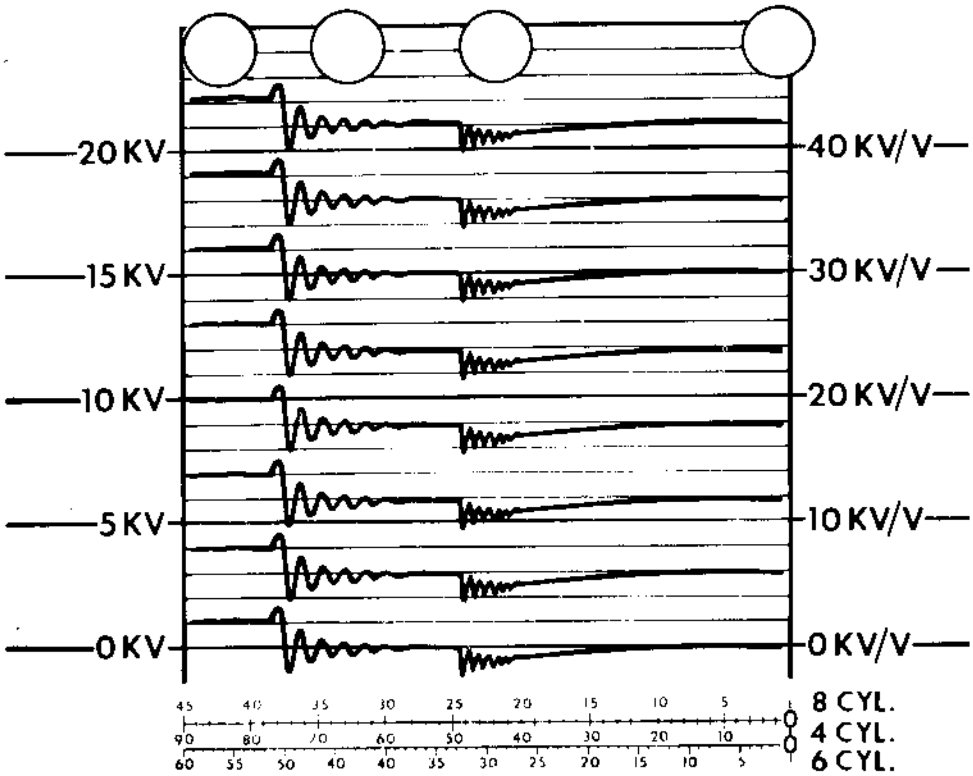
Make this test to determine if there are any problems in the engine which affect power output, by comparing the POWER BALANCE between cylinders.

1. Connect the secondary and primary Scope pattern pick-up leads to the engine.
2. Connect the trigger pick-up lead to the No. 1 spark plug wire.
3. Set the RPM switch to 1000 or AUTO and the cycle switch to the proper position.
4. Set the CYLINDER switch to the correct number of cylinders.
5. Start engine and allow it to warm-up.
6. Set the engine speed to any steady speed between 800 and 1000 RPM. Record the RPM.
7. Press the 1st button to short out the number 1 cylinder. Record the RPM at which the engine is now running.
8. Press the "1st" button again to return the cylinder to operation.



10. Identify the sections of this Raster pattern which show the condition of: (write correct letter in circle)

- A. Coil and condenser
- B. Points during closing
- C. Spark plugs and wires
- D. Points during opening
- E. Voltage required to fire spark plugs



GROUNDING PROBE
(Also called Resistance Test Contactor)

The grounding probe may be used to pinpoint problems in the secondary circuit. The probe is used to ground out sections of the secondary circuit starting at the spark plug. A problem seen on the scope will disappear when the component or components causing the problem are grounded out because the grounding probe offers an easier path to ground than the original circuit. These instructions show how to use this simple tool to pinpoint the cause of high firing voltage or high resistance.

PINPOINTING THE CAUSE OF HIGH FIRING VOLTAGES

Follow these steps to determine what component is the cause of a high firing voltage in one cylinder. If all firing voltages are equally high, check the rotor, distributor cap and coil wire for opens or breaks with the ohmmeter and by visual inspection.

1. Select, from the scope's DISPLAY pattern, a cylinder with a higher than normal firing voltage.

2. Stop the engine and place a spark plug adapter between the spark plug and the spark plug wire.

3. Restart the engine.

4. Connect one end of the 18" extension wire to the grounding probe and the other end to a good engine ground.

5. Touch the tip of the grounding probe to the spark plug adapter. This grounds out the spark plug. Look at the firing line on the scope.

   RESULTS - If the firing voltage drops to 5 to 7 KV, the cause of the high firing voltage is a wide gap or worn electrode on the spark plug or an engine condition such as a lean fuel mixture. If the firing voltage does not drop to 5 to 7 KV, then the problem is not spark plugs, engine condition or the fuel mixture. Continue to step 6.

GROUNDING PROBE

6. Pull the spark plug wire out of the distributor cap using the insulated pliers and then stick the grounding probe down into the distributor tower. Be careful not to break or to damage the distributor tower.

RESULTS - If the firing voltage drops to 5 to 7 KV, the cause of the high firing voltage is the spark plug wire or a poor connection at the distributor tower.

If the firing voltage does not drop to 5 to 7 KV, the cause of the high firing voltage is in the distributor.

PIN POINTING THE CAUSE OF HIGH RESISTANCE

Follow these steps to determine what component is the cause of high resistance in one cylinder. High resistance is indicated when the spark line slopes sharply downward. If all the spark lines are equally bad; check the rotor, distributor cap and coil wire with an ohmmeter and by visual inspection.

1. Select the cylinder with a spark line that slopes sharply downwards.
2. Stop the engine and (a) place a spark plug adapter between the spark plug and the spark plug wire. (b) pull the boot back on the spark plug wire at the distributor cap tower.
3. Restart the engine.
4. Connect one end of the 18" extension wire to the grounding probe and the other end to a good engine ground.
5. Touch the tip of the grounding probe to the spark plug adapter. This grounds out the spark plug. Look at the spark line on the scope.

   RESULTS - If the spark line gets longer and levels out, the cause of the high resistance is the spark plug.
   If the spark line does not change or does not level out, then the problem is not in the spark plug. Continue to step 6.

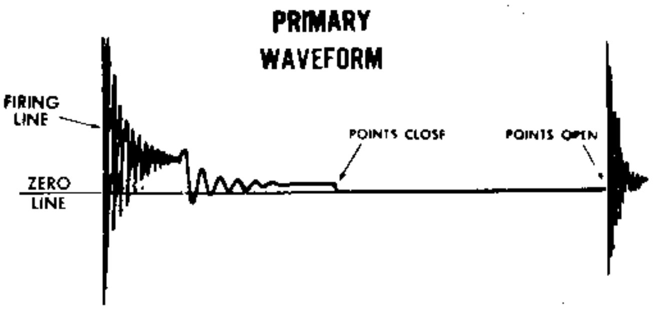
6. Pull the spark plug wire out of the distributor cap using the insulated pliers and stick the grounding probe down into the distributor tower. Be careful not to break the wire's insulation or to damage the distributor tower.

   RESULTS - If the spark line gets longer and levels out, the cause of the high resistance is the spark plug wire or a poor connection at the distributor tower.

   If the spark line does not change or does not level out, then the high resistance is in the distributor cap.

SUN SCOPE
PRIMARY CIRCUIT SYSTEM TESTING

The scope measures the voltage in the primary ignition circuit. This voltage is seen on the scope as a voltage and time picture. The scope shows the voltage in the primary circuit during the time the spark plug is firing, the action of the coil and condenser and the condition of the contact points as they close and open. It also shows the accuracy at which the ignition system fires each plug with respect to the mechanical operation of the engine.



Testing the primary circuit requires the use of the Red and Black leads, part of the Pattern Pick-up cable and the Trigger Pick-up.

The Circuit Selector is placed in PRIMARY + or -, depending on the vehicle's ground. The PRIMARY PATTERN HEIGHT CONTROL should be in the 400 V position.

DETAIL TESTS

FIRING SECTION

Make this test to determine if the primary circuit, the coil, condenser and the wiring are functioning properly while the spark plug is firing.

1. Set the scope control for DISPLAY.
2. Start the engine and set the speed to approximately 1000 RPM.
3. Look at the firing section.

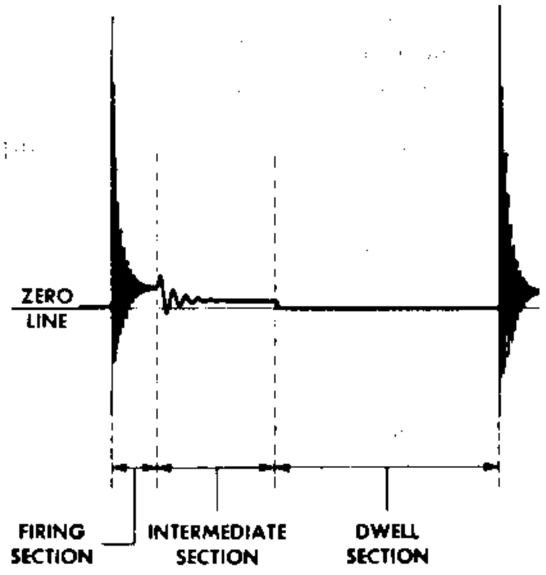
   GOOD Diminishing oscillations.

   BAD Distorted oscillations indicate problems in the secondary circuit such as: bad plugs or excessive secondary resistance.
4. Move the CIRCUIT SELECTOR to RASTER.

INTERMEDIATE SECTION

Make this test to determine if the coil and condenser are working properly.

5. Look at the intermediate section of the trace.



GOOD Several diminishing oscillations.

BAD Only one oscillation or misformed oscillations indicates problems in the coil, condenser or the primary circuit.

POINT CLOSE

Make this test to determine if the ignition contact points are closing properly.

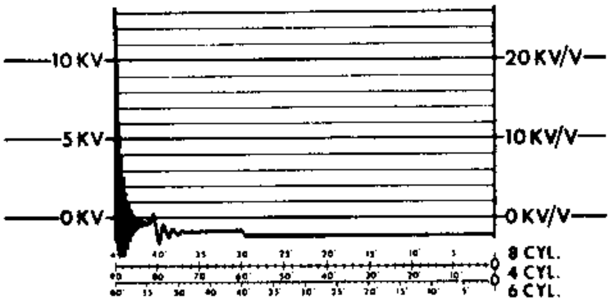
6. Look at the point close.

   GOOD A short downward line followed by a level line.

   BAD Any upwards spike or hash on the trace after the downwards line indicates arcing due to dirty, misaligned or pitted points or that they are bouncing due to incorrect point spring tension.

POINT OPEN

Make this test to determine if the ignition contact points are opening properly.



7. Look at point open.

   GOOD A sharp upwards turning of the trace.

   BAD Hash or a step in the trace where it turns upwards indicates arcing due to dirty, misaligned contacts, pitting on the contact surfaces or improper condenser action.

8. Move the PATTERN SELECTOR to SUPERIMPOSED.

CAM LOBE ACCURACY (Cylinder Timing Accuracy)

Make this test to determine if the distributor cam lobes or distributor drive problems are affecting the timing at which each cylinder fires.

9. Look at the point open.

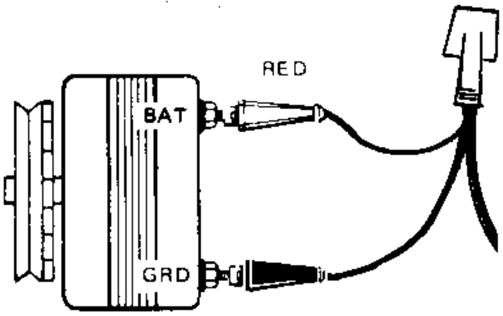
   GOOD The point openings are within 2° of each other.

   BAD More than 2° between point openings indicates problems in the distributor or its drive. Test the distributor in a distributor tester.

SCOPE ALTERNATOR TESTING

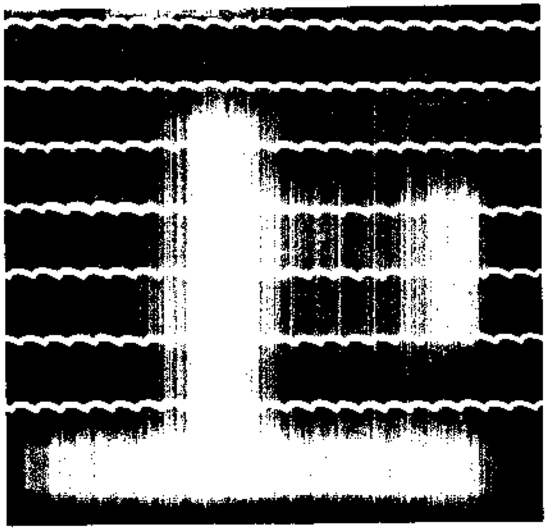
An oscilloscope, when used properly, can be useful for purposes other than analyzing ignition systems. One such use is checking alternator rectifier diodes and the stator. The alternator need not be removed from the engine for this test, since the test is performed with the alternator operating under normal conditions. However, if defective stator or diodes are indicated the alternator must be removed, diodes tested and either diode or stator replaced.

This test does not replace the charging system output and voltage test. Final charging system tests should be accomplished using a Sun Volts Ampere Tester.

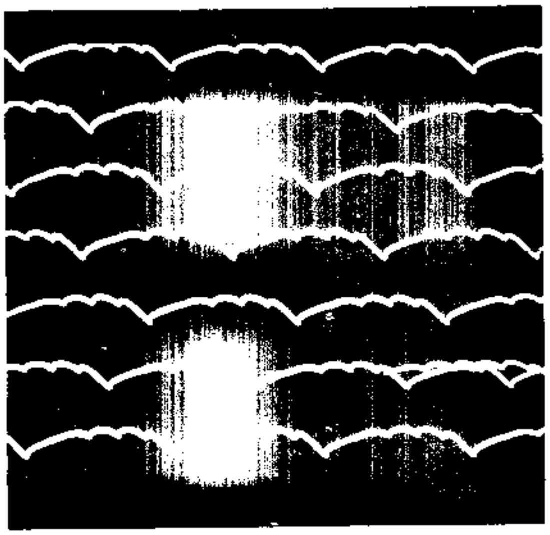


TEST PROCEDURE

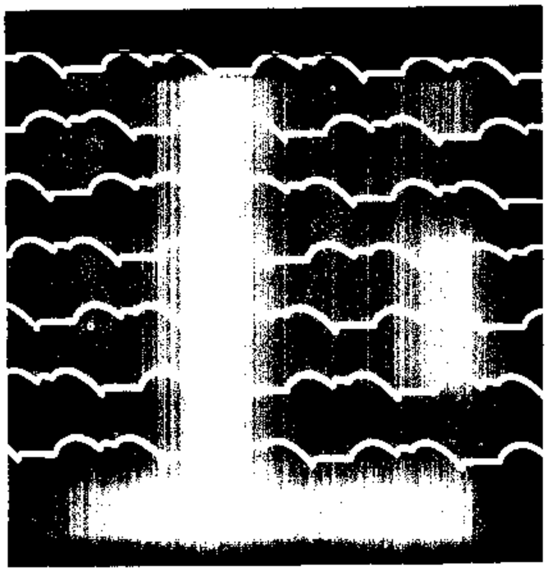
1. Turn Pattern Selector to the Raster position.
2. Turn Circuit Selector to Primary Negative for negative ground systems, or Primary Positive for positive ground systems.
3. Set the Primary Height Control to 40 V position.
4. Tester Connections
    a. Clamp the chrome pick-up around the coil high tension wire.
    b. Clamp the Red Trigger Pick-up around the No. 1 spark plug wire, near the distributor cap.
    c. Connect the Red Primary Pick-up to the Alternator Output (Bat.) terminal.



Normal Alternator



Open Diode



Shorted Diode

   d. Connect the Black Ground Clamp to the alternator or engine ground.

5. Start the engine and operate at approximately 1000 RPM.

6. Turn headlights on and to high beam to apply an electrical load to the alternator.

7. Adjust Pattern Length Control full counterclockwise.

8. Adjust brightness as required.

9. Observe waveform and compare with illustrations.

Results and indications -

If waveform is other than normal, alternator must be removed from vehicle for service.

[redacted]

NAME ____________________

DATE ____________________

SUN SCOPE QUIZ II

1. The Sun Scope displays a graph-like picture of the ignition cycle showing

   A. Voltage and current
   B. Voltage and resistance
   C. Voltage and time

2. The amount of voltage required to maintain a spark across the gap of the spark plug is represented by the

   A. Firing line
   B. Spark line
   C. Intermediate oscillations

3. The opening of the ignition breaker points is shown at

   A. The end of the dwell section
   B. The beginning of the dwell section
   C. The end of the spark line

4. To perform an available coil voltage test

   A. Remove a spark plug wire and touch it to ground
   B. Remove a spark plug wire and hold it away from ground
   C. Accelerate the engine abruptly

5. What section of the scope pattern would indicate a faulty condenser?

   A. The firing section
   B. The intermediate section
   C. The dwell section

6. The Spark Plugs Under Load test is used to detect a faulty

   A. Ignition coil
   B. Condenser
   C. Spark plug

7. Primary and Secondary waveforms may be displayed on a Sun Scope.

   True False

8. Excessive secondary resistance will cause a spark line to appear greatly tilted.

   True False

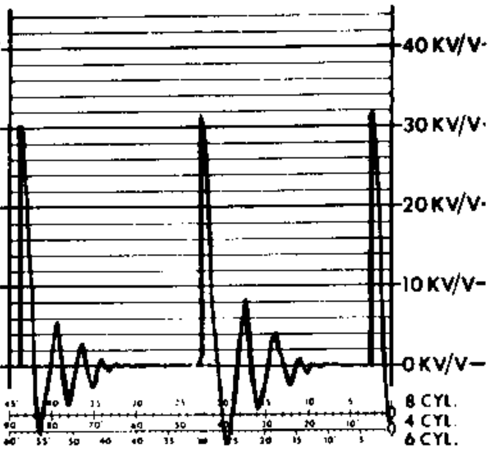
Evaluate the following test results with the scope set to the **40KV range.**

GOOD BAD

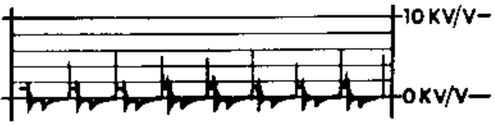
9. VISUAL INSPECTION

loose terminal on #2 wire, oil soaked leads on the left bank ☐ ☐

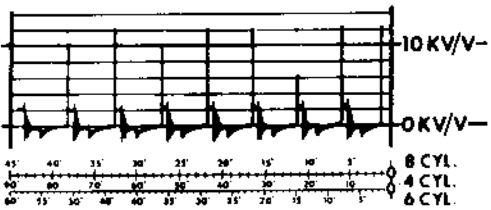
10. CRANKING COIL OUTPUT ☐ ☐



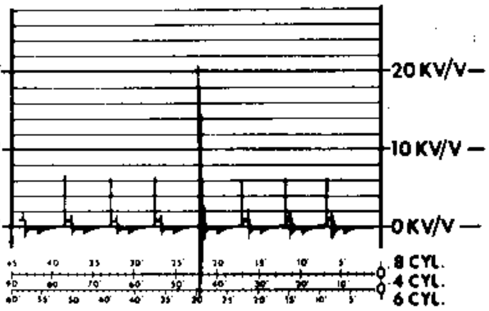
11. COIL POLARITY ☐ ☐



12. SPARK PLUG FIRING VOLTAGE ☐ ☐



13. MAXIMUM COIL OUTPUT AND SECONDARY INSULATION

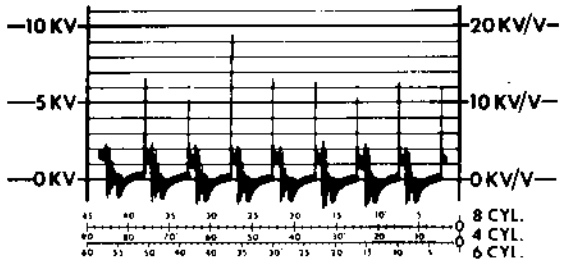


Maximum coil output ☐ ☐

Secondary insulation ☐ ☐

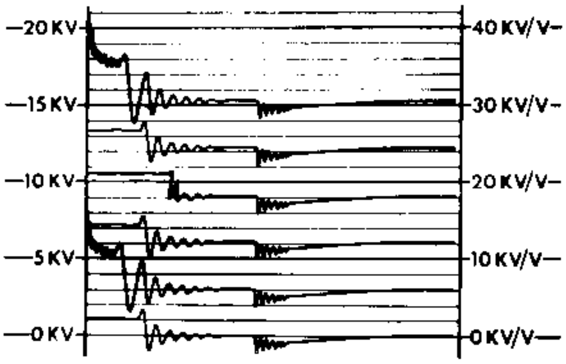
14. SPARK PLUGS UNDER LOAD

GOOD BAD



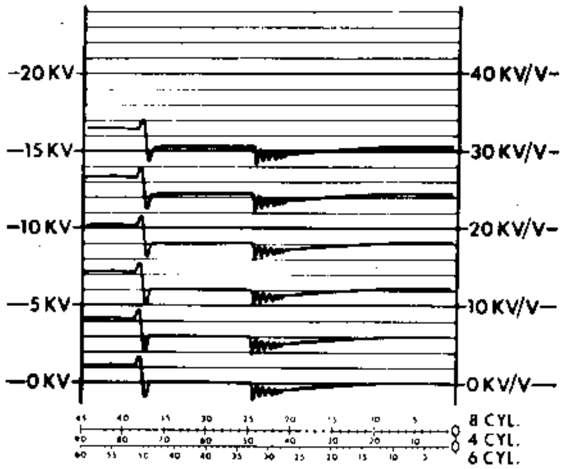
☐ ☐

15. SECONDARY CIRCUIT CONDITION



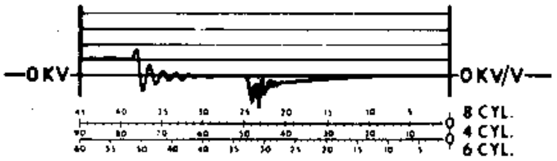
☐ ☐

16. COIL AND CONDENSER CONDITION

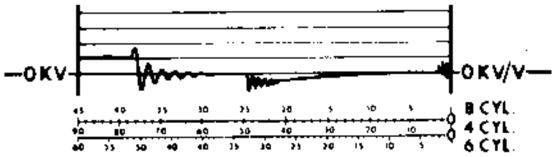


☐ ☐

17. BREAKER POINT CONDITION



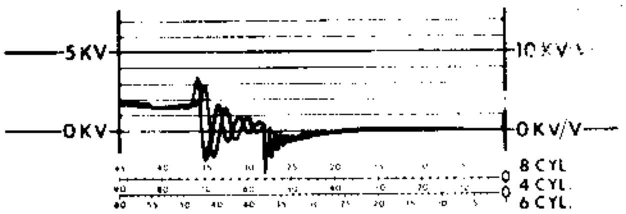
Points closing ☐ ☐



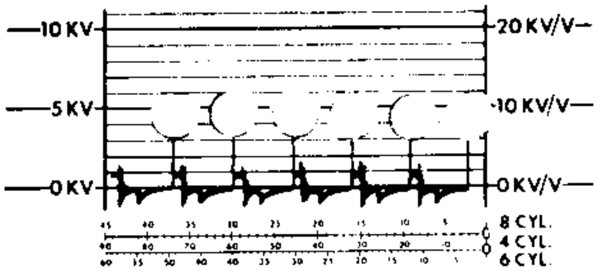
Points opening ☐ ☐

18. CAM LOBE ACCURACY

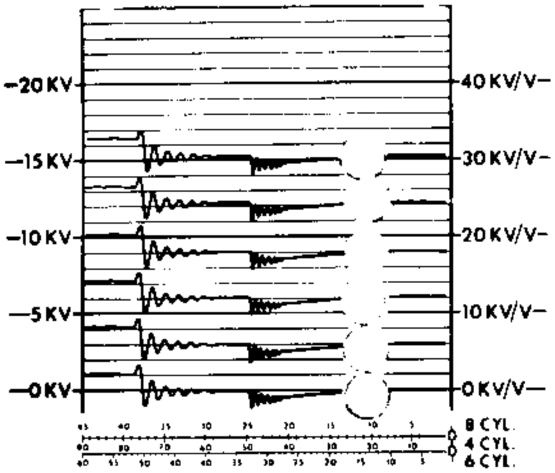
GOOD ☐ BAD ☐



19. Identify each cylinder for an engine with a 1 - 5 - 3 - 6 - 2 - 4 firing order.



20. Identify each cylinder for an engine with a 1 - 5 - 3 - 6 - 2 - 4 firing order.



REMOVING AND REINSTALLING DISTRIBUTOR

These are the basic steps necessary to remove a distributor from an engine for testing and to reinstall it when testing has been completed. There are also instructions that cover reinstallation of a distributor when the engine was cranked over while the distributor was out of the engine.

REMOVAL

1. Remove the distributor cap.
2. Remove the vacuum advance hose or line.
3. Remove the coil to distributor wire at the coil.
4. Remove the distributor hold-down clamp and bolt.
5. Note position of rotor.
6. Pull distributor up and out of the engine noting the position of the rotor as the distributor clears the engine. The distributor is now ready to be tested.

RE-INSTALLING THE DISTRIBUTOR

Installation when the engine was not cranked while the distributor was out.

1. Put the rotor on the distributor shaft.
2. Position the rotor to where it was when the distributor was just removed from the engine.
3. Slide distributor down into the engine. Be sure rotor turns back to original position.
4. If the oil pump drive does not engage, check that rotor is pointing in correct direction.
   - a. If it is not, pull the distributor out and repeat step 3.
   - b. If it is, bump the engine over until the distributor drive drops into the oil pump drive.
5. Reinstall the hold-down clamp and bolt finger tight.
6. Put the distributor cap on.
7. Reconnect the coil to distributor wire to the coil.
8. Reset the initial timing.

REINSTALLING THE DISTRIBUTOR (ENGINE CRANKED OVER)

Follow these steps to install a distributor when the engine was cranked over while the distributor was removed.

1. Remove the spark plug from NO. 1 cylinder.
2. Screw in the proper cylinder leakage adapter hose into NO. 1 cylinder and put the whistle on the end of the hose.
3. Connect the remote starter switch to the starter solenoid.
4. Crank the engine until the whistle stops sounding. The timing marks should be at or near the indicator for TDC.
5. Put the rotor on the distributor shaft.
6. Determine from the specification card the location of NO. 1 tower on the distributor cap.
7. Position the rotor toward where the NO. 1 tower should be and push the distributor into the engine as far as it will go. Note how much the rotor has turned as the drive gear engages.
8. In order to have the rotor point exactly toward NO. 1, pull the distributor back until the drive gear is clear and turn the rotor backwards, far enough, so it will go directly toward NO. 1 when you push it back down.
9. Install the distributor. The rotor will now point to the NO. 1 tower.
10. Hold the distributor body and bump the engine over until the oil pump drive drops into place.
11. Reinstall the hold-down clamp and bolt finger tight.
12. Put the distributor cap on.
13. Reconnect the coil to distributor wire to the coil.
14. Reset the initial timing.

INSPECTION AND MOUNTING

Many distributor problems may be found by a visual inspection and clean-up before testing. Always check for wear or binding in the drive, a loose or binding breaker plate, lack of, or over lubrication, pitted or burnt contact points or bad insulation or connections on pigtail leads before testing.

INSPECTION

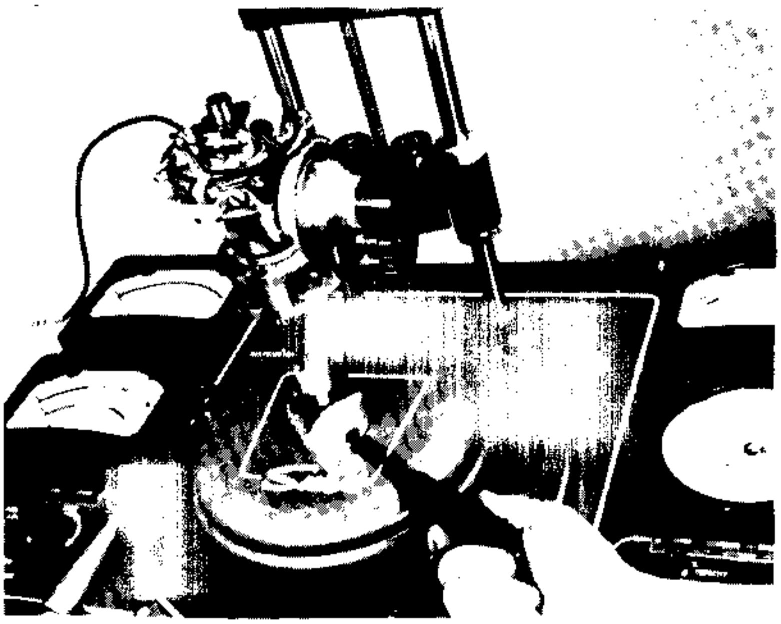
To locate any obvious problems in the distributor which might affect engine operation:

1. Check for excessive side, end play or binding in the distributor shaft. Problems in the distributor drive will cause erratic dwell and cylinder timing.
2. Check for wear in breaker plate bearings. Problems in the breaker plate will affect advance and may cause excessive changes in dwell.
3. Check for proper lubrication. Under lubrication will cause rapid wear of components and over lubrication may cause point resistance problems and deterioration of the insulation within the distributor.
4. Check the cam lobes for wear. Worn cam lobes will affect cylinder to cylinder timing.
5. Check the pigtail leads and connections. Worn or oil soaked insulation may allow the ignition system to short out. Any loose connections cause loss of ignition efficiency.
6. Check the surface condition of the contact points. Dirty, pitted, or burnt contact points will affect ignition output and should be replaced.

MOUNTING DISTRIBUTOR

Proper mounting of the distributor is essential.

1. Raise the clamp arms so the distributor will clear the chuck.
2. Place the distributor in the clamp arms with the vacuum advance chamber pointing to the right. Tighten the clamp lightly.
   a. Always clamp on to the largest machined surface on the distributor body. Use a sleeve adapter to protect "O" ring on distributor body.

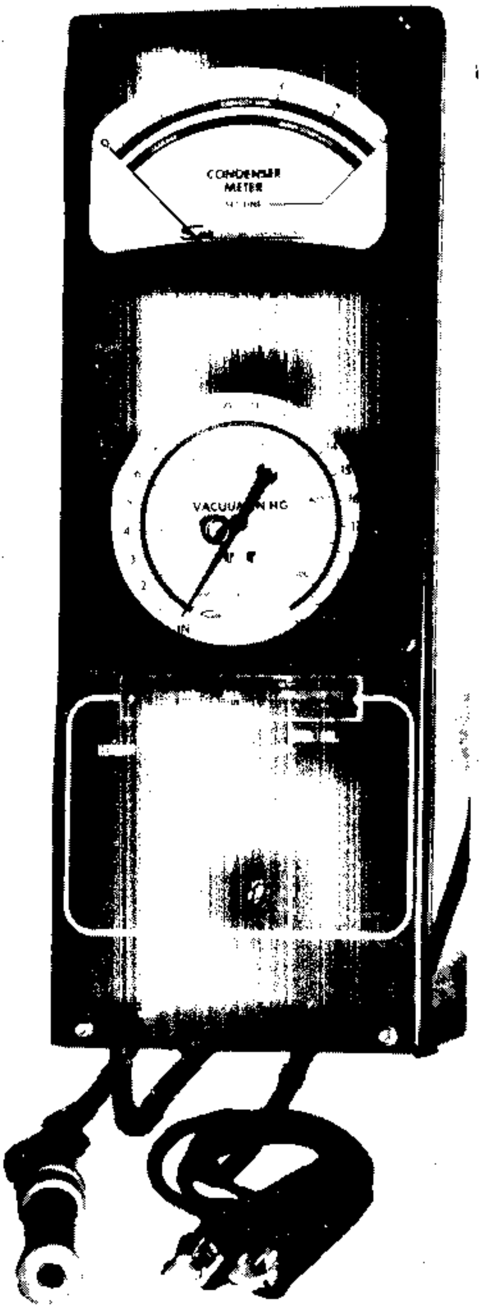


   b. Use the collet adapter if entire body of distributor must rotate.
3. Lower the distributor until the gear or shaft is in the chuck.
   a. Do not bottom the shaft in the chuck.
   b. Use rubber tubes to protect the gear surfaces if necessary.
   c. Use the drive adapter if necessary.
4. Tighten the chuck and clamp arms.
5. Turn the distributor by hand to be sure it's free.
6. Remove the rotor.
If during testing the flashing arrow appears to rotate, check that distributor body and shaft are held firmly by the clamp arms and chuck.

CONDENSER TESTER

The Condenser Tester is used to test the condensers used in the automobile's ignition circuit. Condensers are tested for three conditions, Series Resistance, the amount of resistance in the pigtail lead and the ground circuit, Leakage, the amount of current that can leak from one side of the condenser to the other and Capacity, the amount of energy in microfarads that the condenser can store.

The condenser tester uses the black twin-flex cable on the right panel of the tester. To calibrate the tester, connect the condenser test leads together and turn the COND. CAL. knob from OFF and to the right until the meter reads on the set line.



CONDENSER TESTING

Make this test to determine if the condenser is functioning properly.

1. Turn the MOTOR SWITCH to the proper distributor rotation.
2. Rotate the distributor shaft by hand until the contact points are open.
3. Clip one test lead to the distributor lead, the other lead to the ground stud.
4. Test for Series Resistance.
    a. The CONDENSER TEST knob is spring loaded in the SERIES RESISTANCE position.
    b. The meter should read in the Black Band at the right end of the scale.
    c. Move the pigtail leads. If moving the leads caused the meter to read out of the Black Band or move into the Black Band, then the leads or ground circuit have excess resistance due to broken wires or poor connections. The distributor lead may be eliminated by moving the lead to the end of the condenser pigtail lead and repeating this test.
    d. To check if the excessive resistance is in the ground circuit, move the other test lead to the body of the condenser. If the meter now reads in the Black Band, then check for a poorly grounded condenser or distributor body.

NOTE: If condenser fails any one of these tests, STOP. Do not test any further. Replace this condenser.

5. Test for leakage.

    a. Move the CONDENSER TEST knob to LEAKAGE.

    b. The meter should now read in the Black Band at the left end of the scale.

DO NOT TOUCH THE TEST LEADS OR CONDENSER PIGTAIL WHILE MAKING THIS TEST.

6. Capacity Test.

    a. Move the CONDENSER TEST knob to CAPACITY.

    b. The meter will now read the capacity.

7. Remove the condenser test leads and turn the CONDENSER CALIBRATOR to OFF.

    GOOD Condensers that test in the Black Band for series resistance and leakage and within specification for capacity.

    BAD Condensers that test outside the Black Band for series resistance, or leakage, or the meter moves when pigtail lead is moved during the series resistance test, or are not within capacity specification will affect ignition system operation and should be replaced.

NAME ____________________

DATE ____________________

DISTRIBUTOR TESTING WORKSHEET

ENGINE No. __________ MAKE/YEAR ______________ DISTRIBUTOR No. __________

CONDENSER

			GOOD	BAD
Series leakage	spec BLACKBAND IN OUT		☐	☐
Leakage	spec BLACKBAND IN OUT		☐	☐
Capacity	spec ___ _____MFD	Measured _______MFD	☐	☐

CONTACT POINTS

Surface condition	VISUAL INSPECTION		☐	☐
Point spring tension	spec ____________	Measured ____________	☐	☐
Rubbing block	VISUAL INSPECTION		☐	☐
Contact point alignment	VISUAL INSPECTION		☐	☐
Contact point resistance	spec BLACKBAND IN OUT		☐	☐
Dwell	spec ____________	Measured ____________	☐	☐
Dwell variation	spec ____________	Measured ____________	☐	☐
Point float	spec 3° drop	Measured ____________	☐	☐
Point bounce	No extra arrows		☐	☐

DISTRIBUTOR - MECHANICAL COMPONENTS

Cam lobe accuracy	spec ± 1°	**Measured** ____________	☐	☐
Bushings, shaft				
Breaker plate condition	VISUAL INSPECTION		☐	☐

MECHANICAL ADVANCE

Starting point	spec ____________	Measured ____________	☐	☐
Low	spec ______° @ ______	Measured ______°	☐	☐
Intermediate	spec ______° @ ______	Measured ______°	☐	☐
High speed	spec ______° @ ______	Measured ______°	☐	☐
Mech. Spark retard	Returns to zero		☐	☐

VACUUM ADVANCE

Vac. Chamber leak	HOLDS VACUUM		☐	☐
Vac. Plate action	VISUAL INSPECTION		☐	☐
Starting point	spec ______" ______	Measured ______"	☐	☐

DISTRIBUTOR TESTING WORKSHEET (con't.)

VACUUM ADVANCE (con't.)

		GOOD	BAD
Low vacuum	spec _____° @ _____" Measured _____°	☐	☐
Intermediate vacuum	spec _____° @ _____" Measured _____°	☐	☐
High vacuum	spec _____° @ _____" Measured _____°	☐	☐
VAC Spark retard	Returns to zero	☐	☐

IGNITION CONTACT POINTS

The ignition contact points must close and open hundreds of times per minute during operation and continue to do this for thousands of miles. To be sure they will operate correctly under all conditions, they must be carefully tested. This testing includes: setting for proper dwell angle, testing point spring tension, alignment, resistance and operation at all speeds.
To test the contact points, the distributor tester's drive unit, tachometer and dwell meter are used.

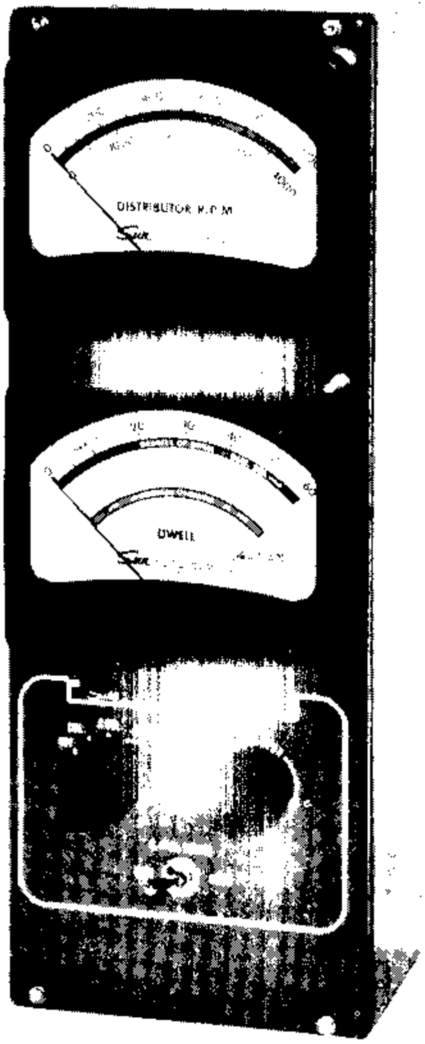
The drive unit is controlled by a two-position motor switch which turns on power to the tester and controls the direction of rotation.

A speed control crank allows you to vary the RPM.

The tachometer is driven internally off the drive unit and needs no connections.

The dwell meter uses the Red and Black test leads on Drive unit.

To calibrate the Dwell meter, connect the Red and Black test lead together. Turn the dwell meter switch to CALIBRATE. Turn the MOTOR switch to the proper direction of rotation. Now turn the DWELL CALIBRATOR knob until the meter reads on the Set Line at the right end of the scale. Before testing, turn the dwell meter switch to the correct number of cylinder position.



VISUAL INSPECTION

Make this test on points that have been in service.

1. Visually inspect the points.

   GOOD   Light gray color with the contact area in the center of the points surface.

   BAD   Pitted, arced, or burnt contact points should be replaced before testing.

POINT SPRING TENSION

Make this test to determine if the spring tension is within specification so the contact points close properly at all speeds.

1. Connect the Red lead to the distributor's lead and the Black lead to the grounding stud.
2. Turn the distributor shaft until the contact points are closed. Turn the MOTOR switch to the proper distributor rotation position.
3. Hook the Spring Tension Gauge over contact points and pull at right angles to the contact point lever.

CONTACT POINT TESTING

4. Record the reading of the Spring Tension Gauge when the arrow flashes or when the dwell meter starts to fall to 0.

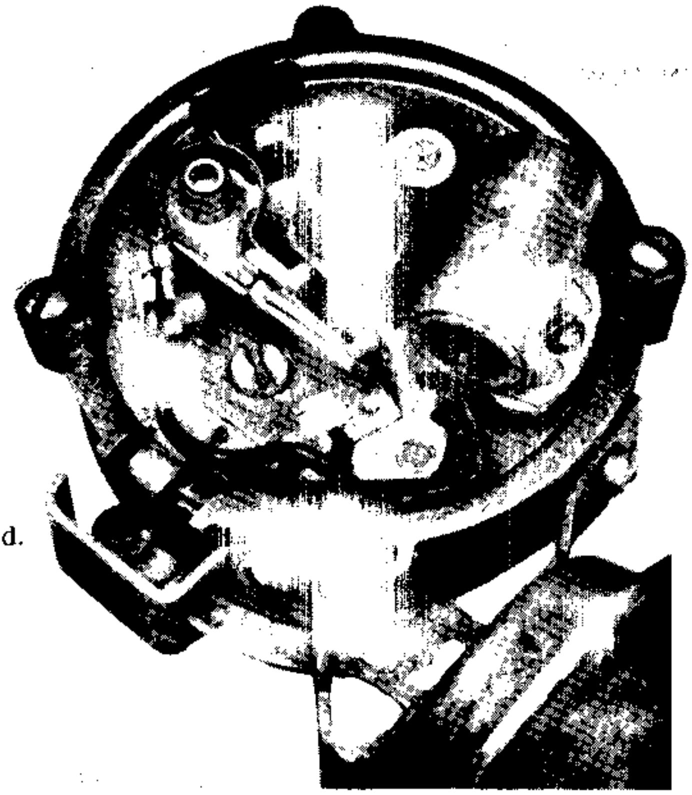
   GOOD The point spring tension is within specifications.

   BAD Low spring tension will allow the points to remain open too long (float) at higher speeds. High readings indicates binding at the point's pivot or excessive spring tension which will cause the points to bounce open due to impact when they close. Contacts with incorrect spring tension should be replaced.

5. Binding at the contact pivot may be determined by slowly closing the contact points and noting the spring tension gauge reading when the dwell meter starts to rise indicating the points are closed.

   GOOD Spring tension the same in both opening and closing.

   BAD Any difference in spring tension indicates binding. This binding usually cannot be corrected and the point set must be replaced for good ignition system performance.



CONTACT POINT ALIGNMENT

Make this test to determine if the contacts need to be aligned to insure maximum life.

1. Turn the speed control to operate the distributor at approximately 1000 RPM.
2. View the contact points from above and from one side. A small spark should be seen near or at the center of points.

   GOOD A spark is seen near the center.

   BAD The spark is seen off to one side. Bend the stationary contact, using a point wrench or suitable tool until the spark is at or near the center.

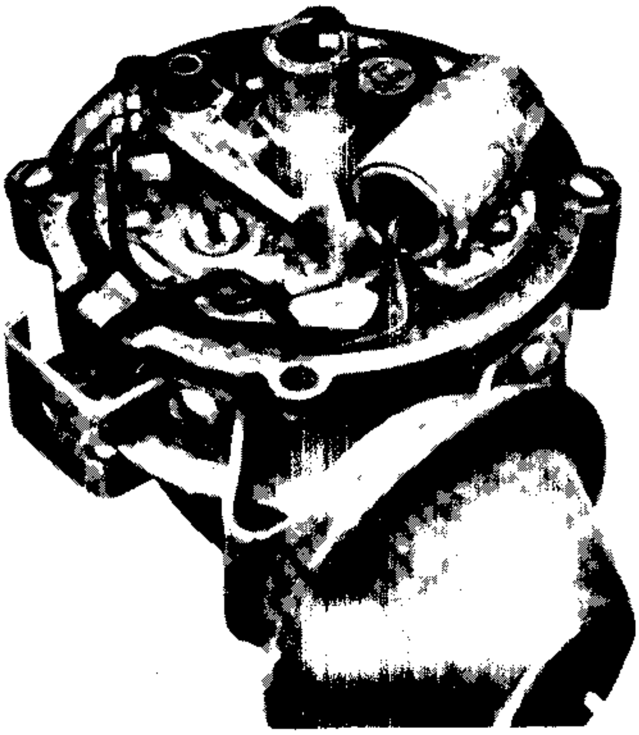
RUBBING BLOCK ALIGNMENT

Make this test to determine if the rubbing block touches the cam squarely. This test detects conditions which lead to rapid rubbing block wear and the resultant change in dwell and ignition timing.

1. While the distributor is operating at 1000 RPM look at the rubbing blocks contact with the cam lobe.

   GOOD The rubbing block touches the cam surface evenly.

   BAD Uneven contact will allow the rubbing block to wear rapidly. This alignment is controlled by the contact's pivot and misalignments of this pivot usually require replacement of the contact set.



Bent or warped breaker plate assemblies may also be responsible for rubbing block misalignments. Problems of this type are not correctable and require replacement of the contact set.

CONTACT POINT RESISTANCE

Make this test to detect excessive resistance due to dirt, oil or other contamination on the contact points, poor lead conditions or bad connections which will affect the ignition performance.

1. Stop the distributor with the contact points closed.
2. Move the dwell switch to CALIBRATE.
3. The dwell meter should read in the Black Band at the right end of the scale. Move the distributor lead and watch the meter. It should not move out of the Black Band.

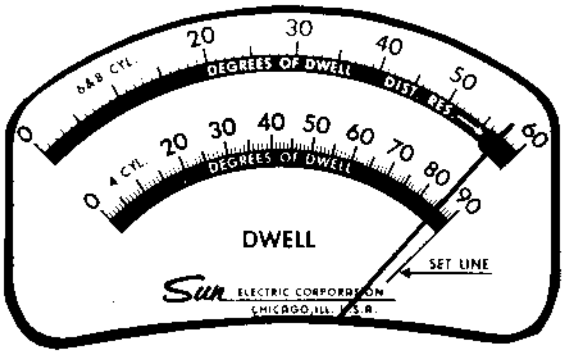
   GOOD Meter reads in the Black Band.

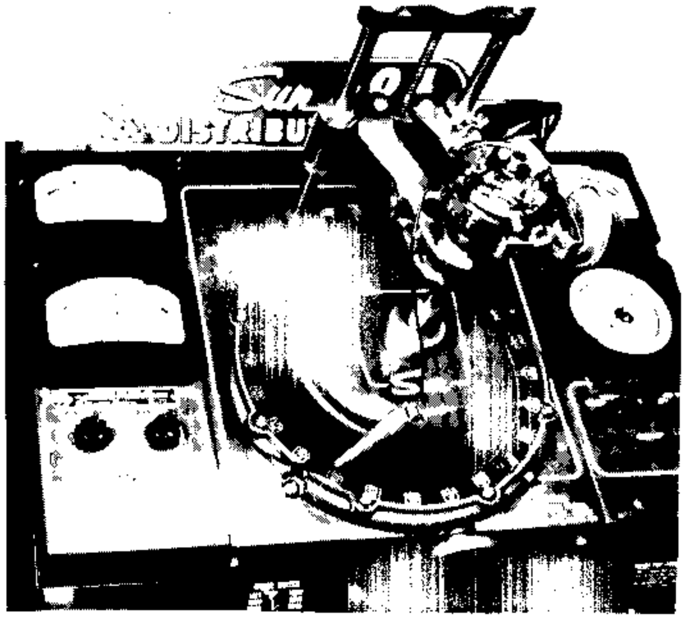
   BAD Meter does not read in the Black Band or moves out of the band when the lead is moved indicates excessive contact resistance which will affect ignition performance. Repeat test with Red test lead connected directly to contact point. If results are good replace distributor pigtail lead. If test remains bad clean contact surfaces with a smooth clean piece of heavy paper and retest, if uncleanable they should be replaced. Do not file or scrape points.
4. Move the dwell switch back to the correct cylinder position.

DWELL

Make this basic adjustment.

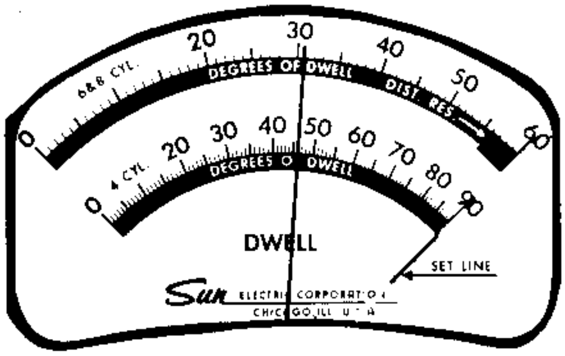
1. Turn the speed control until the distributor is running at 300 RPM. Be sure dwell switch is in the correct position for the number of cylinders being tested.
2. Adjust dwell.
3. Dual point distributor.
   a. Block open one set of contacts.
   b. Adjust dwell of other set.





   c. Repeat steps a and b on other set of contacts.
   d. Remove card and measure total dwell.

DWELL VARIATION



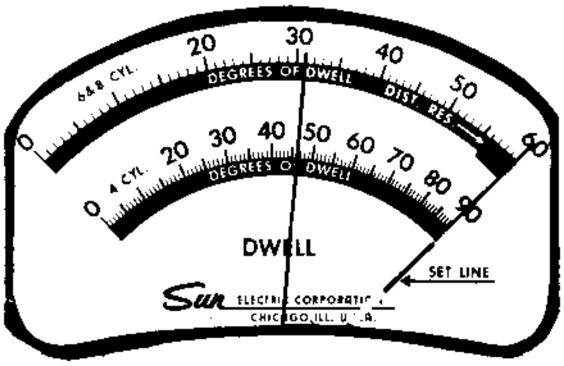
Make this test to determine if worn components within the distributor will cause a change in dwell as the engine speed increases.

1. Increase the distributor speed slowly up to 2500 RPM.
2. Watch the dwell meter for any change in dwell.

   GOOD Dwell changes less than specified dwell variation.

   BAD Gradual change in dwell to beyond specifications indicates mechanical problem in the distributor. Look for worn bearings, bent distributor shaft or a loose breaker plate. If the dwell changes abruptly, see results under Point Float.

POINT FLOAT



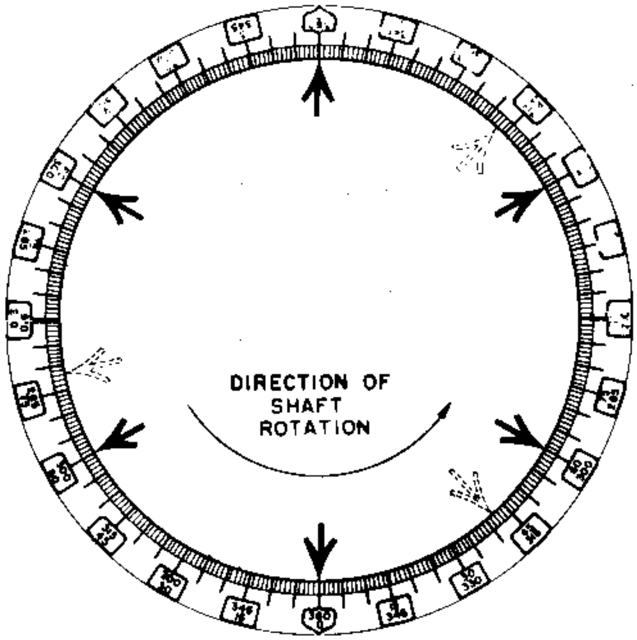
Make this test to determine if the ignition points close at the proper time. Weak spring tension or binding in the spring pivot may cause the points to float or remain open and reduces the dwell time and thus the amount of voltage the coil can produce.

1. Increase the distributor speed to 2500 RPM.
2. Watch the dwell meter for a sudden change in dwell.

   GOOD Dwell does not change abruptly.

   BAD A sudden change in dwell indicates the points floated or remained open for a portion of the dwell period. Low contact spring tension or excessive dwell may be the cause.

POINT BOUNCE



Make this test to determine if the ignition points close, bounce open and then reclose at the start of the dwell period. Each time the points open the coil attempts to fire, using up energy and affecting total ignition output.

1. Increase the distributor speed to 2500 RPM.
2. Watch the flashing arrows. There should be the same number as lobes on the distributor cam.

   GOOD No additional arrows.

   BAD Any additional arrows, indicates the contact points have bounced open and then reclosed. Look for high point spring tension, binding in the contact spring pivot or excessive vibration in the distributor.

MECHANICAL COMPONENTS

The distributor must time the spark to each cylinder so it gets there at the proper instant. To be sure that this occurs the cam lobe and the distributor shaft must be in good condition.

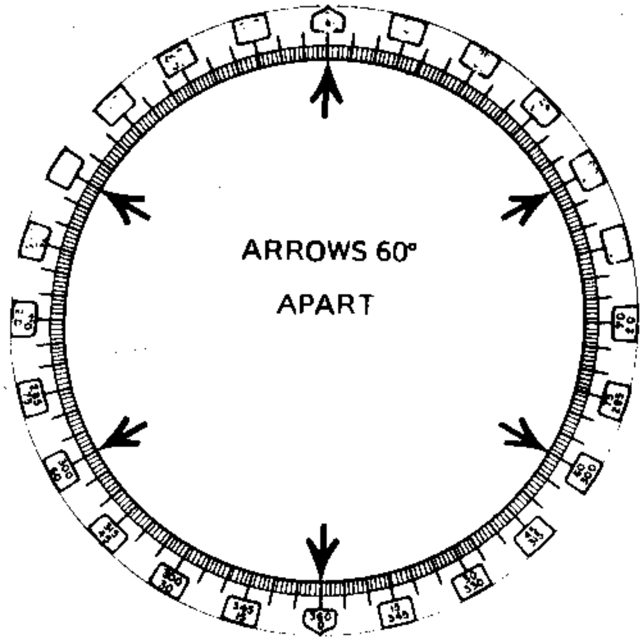
CAM LOBE ACCURACY

Make this test to check out the condition of the cam lobes to be sure they are the specified number of degrees apart.

1. Run the distributor at 1000 RPM.
2. Rotate the DEGREE RING until the zero point is aligned with any of the flashing arrows.
3. Observe each of the other flashing arrows position on the DEGREE RING.

   GOOD The arrow flashes should be evenly spaced, plus or minus 1 degree around the DEGREE RING, 45 degrees apart for 8 lobe cams, 60 degrees apart for 6 lobe cams, and 90 degrees apart for 4 lobe cams.

   BAD Arrows that are not within 1 degree of their correct location indicate distributor problems such as a worn cam lobe, hent shaft or worn bearings.



(6 cylinder engine)

BUSHING, SHAFT AND BREAKER PLATE CONDITION

Make this test to determine if the distributor shaft or its bushings or the breaker plate has excessive play during operation which might cause problems.

1. Vary distributor speed from 300 to 2500 RPM.
2. Visually inspect the distributor shaft and breaker plate for run out.

   GOOD No visual run out.

   BAD Wobble or excessive run out indicates a bent shaft, a worn bushing or breaker plate which will affect ignition operation.

MECHANICAL ADVANCE

Make this test to determine if the mechanical (centrifugal or speed operated) advance system causes the timing to advance the correct amount at all engine speeds.

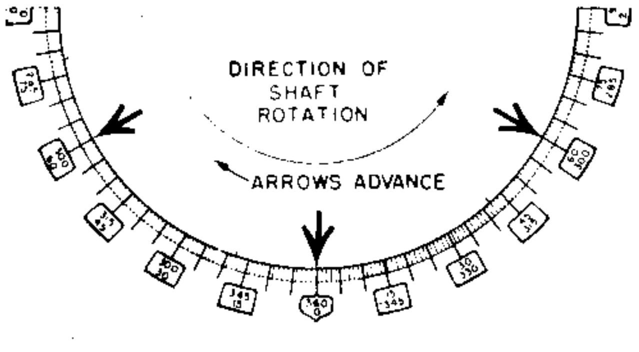
1. Run the distributor at approximately 200 RPM.
2. Set ZERO on the DEGREE RING to any flashing arrow.
3. Increase the distributor speed to the first specified test speed. Record the new position of the arrow on the degree ring.
4. Increase the distributor speed to each of the other specified speeds and record the change in the arrow's position.
5. Reduce the distributor speed back to the speed in step 1. The arrow should return to the Zero set in step 2.

GOOD The arrow advances the specified amount at each of the test speeds and the arrow returns to its starting point when the distributor's speed is returned to its starting RPM.

BAD Incorrect advance at any speed indicates a need for service or replacement.

a. If advance is bad at low speeds, good at high speeds, look for wear, binding and dirt.

b. If advance is too much or too little at all speeds – look for incorrect springs and weights.



VACUUM ADVANCE

Make these tests to determine if the distributor's vacuum advance system controls the timing under all operating (vacuum) conditions for maximum fuel economy and emission control.

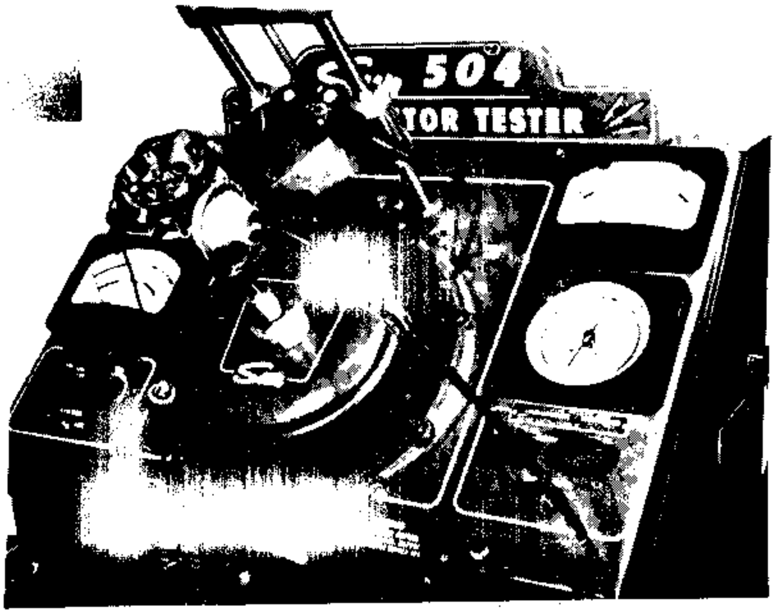
VACUUM CHAMBER LEAK TEST

Make this test to determine if the vacuum advance chamber has any leaks in its diaphragm which might affect its operation.

1. Turn distributor speed to Zero.
2. Connect the vacuum hose to the distributor vacuum advance port.
3. Clip the vacuum hose closed.
4. Adjust the vacuum regulator until the vacuum gauge reads about 15 inches.
5. Open the clip on the vacuum hose. Watch the vacuum gauge.

   GOOD Vacuum first drops towards zero, then climbs back to vacuum set in step NO. 4.

   BAD Vacuum that does not climb back to original setting indicates the diaphragm has a leak and should be replaced.



VACUUM PLATE ACTION

Make this test to determine that there is no excessive binding or wear in the vacuum advance mechanism that might affect the advance.

1. Set distributor speed to approximately 200 RPM.
2. Vary vacuum from 0 to 20".

VACUUM ADVANCE

3. Observe motion of breaker plate.

   GOOD Breaker plate moves smoothly as vacuum is varied.

   BAD Breaker plate does not move or moves in a series of jerks indicates binding or excessive wear. A small amount of lubrication on the mechanism may help reduce binding. Worn parts should be replaced.

4. Repeat the vacuum plate action test and watch the dwell meter.

   GOOD Breaker plates that pivot about the distributor shaft less than 2 degrees change in dwell.

   Breaker plates that have an off-center pivot (some Fords, Chryslers, etc.,) 5 to 7 degrees change in dwell.

   BAD If the dwell varies more than specified, look for worn breaker plate bearings.

VACUUM ADVANCE

Make this test to determine if the vacuum advance system causes the timing to change the correct amount at all specified vacuum levels.

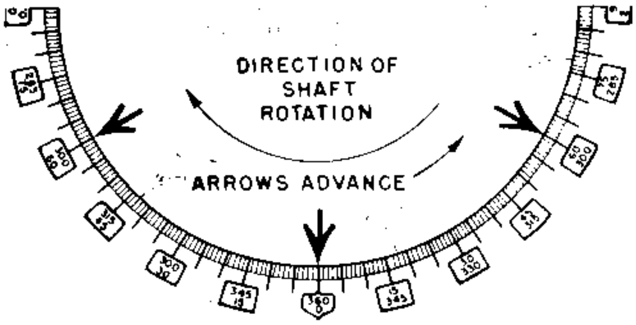
1. Set the distributor speed to approximately 200 RPM.

2. Set the ZERO on the DEGREE RING to any flashing arrow.

3. Increase the vacuum and record when the arrow first starts to move.

4. Increase the vacuum for first specified vacuum and record the new position of the arrow on DEGREE RING.

5. Increase the vacuum to each of the specified amounts and record the new position of the arrow on the DEGREE RING.



6. Reduce the vacuum to zero. The arrow should return to the ZERO set in step 2.

   GOOD The arrow advances the specified amounts at each specified vacuum and the arrow returns to its starting point when the vacuum is returned to zero.

   BAD Incorrect advance at any vacuum indicates a need for service or replacement of the vacuum advance system. Problems in the vacuum advance system will affect economy and general engine performance.

VACUUM RETARD

Make this test to determine if the vacuum retard system causes the timing to change the correct amount at all specified vacuum levels for proper emission controls.

Follow the procedure for vacuum advance testing.

ELECTRONIC DISTRIBUTOR CONTROLS

Make this test to determine if the electronic distributor control causes the specified changes in timing under simulated operating condition.

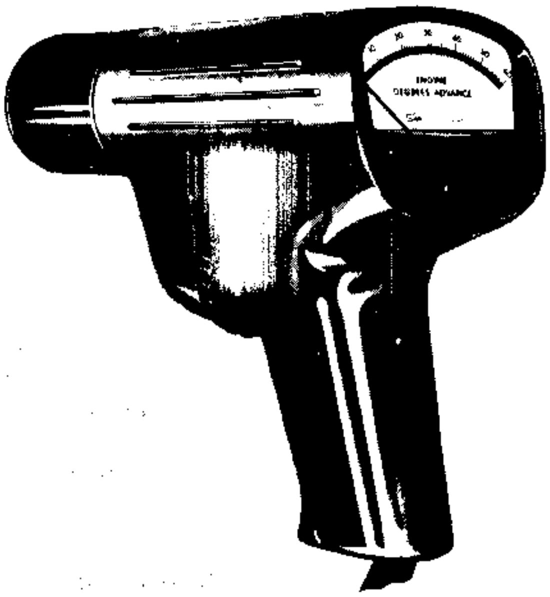
1. See manufacturer's manuals for testing procedure.

2. Use flashing arrows and DEGREE RING to measure amount of advance or retard.

   See manufacturer's manual for specifications.

TIMING ADVANCE UNIT

The Timing Advance Unit is a power **timing light** with a built-in meter to measure the amount of advance or retardation of the spark due to action of the mechanical, vacuum advances or electronic control devices. This unit is used to test or set the initial timing and to quickly test the action of the advance/retard devices.



The Timing Advance Unit is used with the **trigger pick-up lead** connected to the timing cylinder.

AREA TESTS

INITIAL TIMING

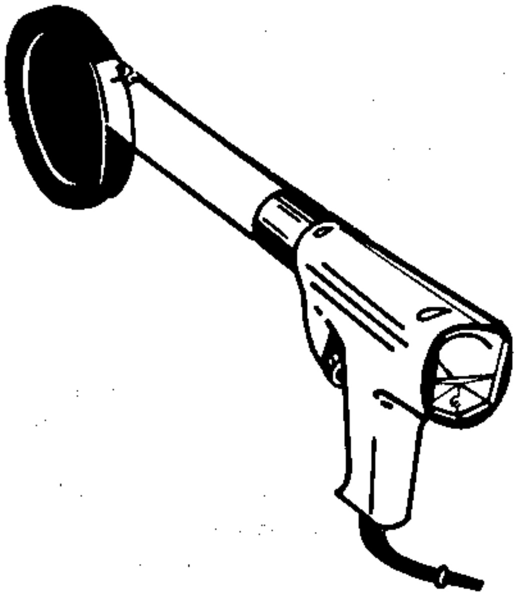
To test or set the initial or basic timing.

1. Connect trigger pick-up to the timing cylinder, usually NO. 1.
2. Place the cycle selector switch to the proper position, 4 CYCLE or 2 CYCLE.
3. Turn the ENGINE RPM knob to AUTO or 1000.
4. Start and warm up the engine.
5. Set the engine RPM to the speed specified for initial timing.
6. Remove or disconnect vacuum hoses if specified. Plug vacuum source to prevent RPM change.
7. Turn TIME/ADVANCE knob on the unit to the TIME position.
8. Aim Timing Advance unit at timing marks and press button. Note position of Timing Marks.

   GOOD Initial Timing within 1° of specification.

   BAD Timing marks not within 1° of specification.

9. Replace vacuum line(s) if removed.



TIMING ADVANCE

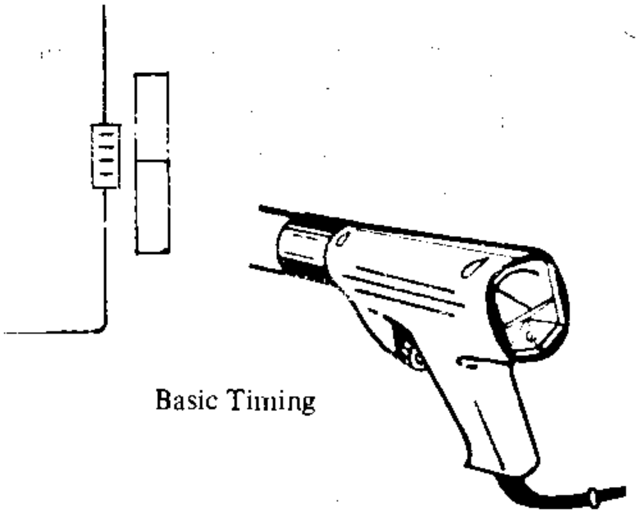
Make this test to determine quickly if mechanical and vacuum advance or electronic control devices are producing sufficient advance for proper operation.

1. Set ENGINE RPM knob to AUTO or 5000.
2. Set engine speed to 2500 RPM.
3. Aim Timing Advance unit at timing marks and press button.
4. Turn the TIME/ADVANCE knob until the timing mark moves back to the point where it was at idle (initial timing setting).

   Note reading on the meter on the back of the Timing Advance Unit.

   GOOD Advance readings within specifications for total advance.

   BAD Advance readings not within specifications indicate problems with either the mechanical or vacuum advance system. Use the timing advance unit to pinpoint the problem area.



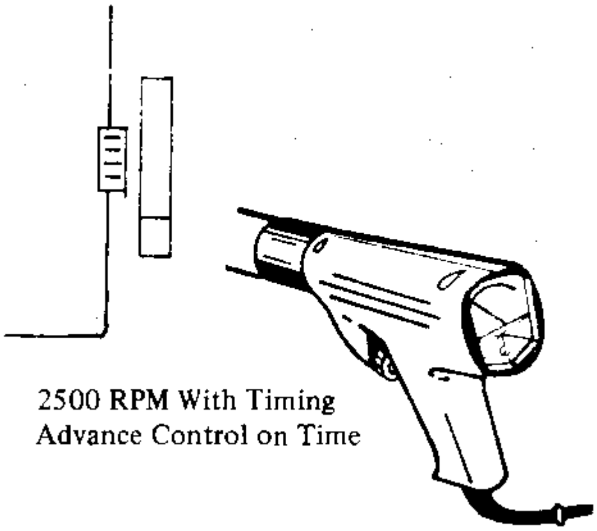
Basic Timing

DETAIL TESTS

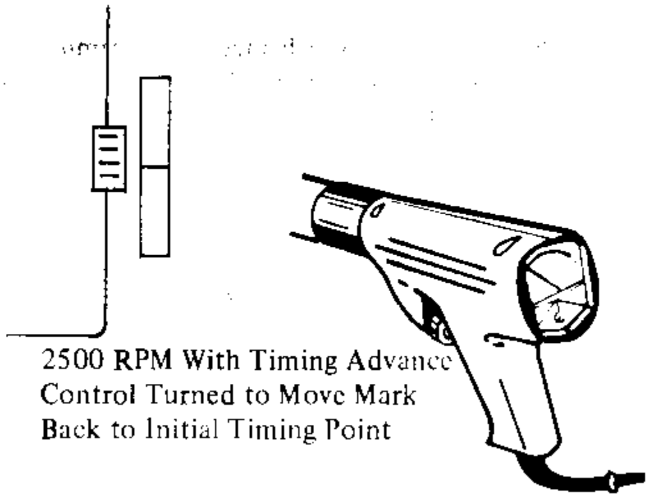
TIMING ADVANCE

Make this test to pinpoint the lack of proper total advance to either a defective vacuum or mechanical (centrifugal) advance system. This test is done only when the total advance readings made above do not meet the specifications. During this test the vacuum advance is disconnected and the meter will read only the amount of advance caused by the action of the mechanical advance.

1. Disconnect vacuum advance line or hose from distributors vacuum advance mechanism.
2. Set the engine speed to 2500 RPM. Turn the TIME/ADVANCE knob until the timing mark moves back to the point where it was at the initial timing point.
3. Note advance reading.



2500 RPM With Timing Advance Control on Time

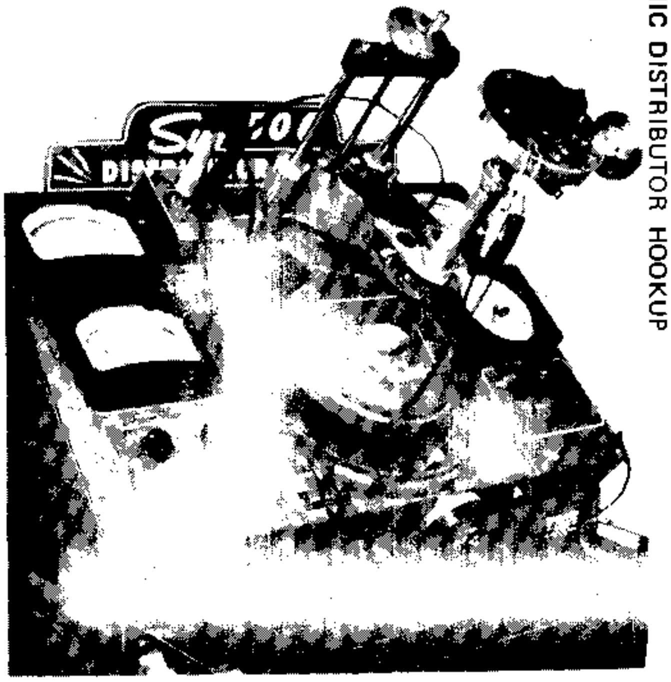


2500 RPM With Timing Advance Control Turned to Move Mark Back to Initial Timing Point

RESULTS: Meter should read within the specifications for Mech or Cent. (mechanical or centrifugal) advance. If it does, then the vacuum advance mechanism needs service. If the meter does not read within specifications for Mech or Cent advance system then the mechanical advance needs service.

ELECTRONIC DISTRIBUTOR TESTING

The Distributor Pulse Amplifier acts as an amplifier for magnetic impulse type ignition systems to operate the distributor tester Tachometer and Flash tube. The DPA is applicable to Chrysler, Ford and General Motors electronic ignition systems and other magnetic impulse type electronic ignition systems. The DPA is not applicable to systems that do not generate their own magnetic impulse type signal such as Prestolite BID Systems used on American Motors, Jeep and International.



Ford, Chrysler and GMC Hookup

1. Mount distributor in tester in the usual manner.
2. Connect distributor vacuum hose to the distributor vacuum advance unit.
3. Inspect distributor leads and connector plug terminal(s) for corrosion and mold rubber interference.
4. Connect the DPA test leads to the magnetic pickup assembly.

NOTE: When using the DPA to test distributors used with Chrysler and Ford electronic ignition systems, the polarity of the DPA lead connections to the distributor magnetic pickup assembly is immaterial. However, on Delco-Remy HEI systems it is important that proper polarity be observed. The magnetic pickup assembly leads must first be disconnected from the electronic module, then the DPA leads and magnetic pickup assembly leads are connected green to green and black to white.

5. Connect the Red Distributor Tester lead to the Red terminal of the DPA, and connect the Black Distributor Tester lead to the Black DPA terminal.

Prestolite Hookup (Used on American Motors, Jeep and International)

1. Mount the distributor in the Distributor Tester in the usual manner with the vacuum advance chamber in the 11 o'clock position.

2. Mount the Prestolite Vehicle Control Unit on the tester in any convenient manner.

3. Connect the two conductor plug from the distributor to the four conductor plug from the Control Unit. Match lead colors as follows: Black to White, and Black and Green to Blue.

4. Insert a Sun adapter # 3676-501 into the socket of the four conductor plug that is connected to the Control Unit's Green wire.

5. Connect the Tester's Red-booted distributor lead to adapter # 3676-501.

6. Connect a jumper lead from the positive battery post to the exposed terminal of the four conductor plug that is connected to the Control Unit's Yellow wire.

7. Connect the Black lead from the Control Unit and the Distributor Tester ground lead to the negative post of the battery. Use jumper leads.

NOTE: Use a fully charged 12 volt battery to power the system to be tested.

CYLINDER TIMING ACCURACY

The distributor must time the spark to each cylinder so it gets there at the proper instant. To be sure that this occurs, the pulse generator and the distributor shaft must be in good condition.

Make this test to check the condition of the pulse generator to be sure these pulses are the specified number of degrees apart.

1. Run the distributor at 1000 RPM.

2. Rotate the DEGREE RING until the zero point is aligned with any of the flashing arrows.

3. Observe each of the other flashing arrows position on the DEGREE RING.

GOOD The arrow flashes should be evenly spaced, plus or minus 1 degree around the DEGREE RING, 45 degrees apart for 8 cylinders, 60 degrees apart for 6 cylinders, and 90 degrees apart for 4 cylinder engines.

BAD Arrows that are not within 1 degree of their correct location indicate distributor problems such as a worn cam lobe, bent shaft or worn bearings.

PICKUP COIL RESISTANCE

1. Disconnect distributor pickup lead plug.
2. Insert a Sun Terminal Adapter into the female terminal of the disconnected plug, where applicable.
3. Connect ohmmeter leads to the plug terminals.

   Ohmmeter reading should be within manufacturer's specifications.

PULSE GENERATOR GROUND TEST

1. Connect on ohmmeter lead to either one of the plug terminals and the other ohmmeter lead to the distributor housing.
2. The ohmmeter should indicate infinite resistance.

AIR GAP TEST (If Applicable)

1. Align a reluctor cam blade with the center of the pickup coil core.
2. Without forcing, attempt to slip a 0.010 inch feeler gauge strip into the gap.
3. The gap should not accept the feeler gauge. If it does, adjust gap to manufacturer's specifications.

MECHANICAL ADVANCE

This test is performed the same as for distributors used in standard ignitions.

VACUUM ADVANCE

This test is performed the same as for distributors used in standard ignitions.

VACUUM RETARD

This test is performed the same as for distributors used in standard ignitions.

VACUUM CHAMBER LEAK TEST

This test is performed the same as for distributors used in standard ignitions.

VACUUM PLATE ACTION

This test is performed the same as for distributors used in standard ignitions.

NAME ____________________
DATE ____________________

ELECTRONIC DISTRIBUTOR TESTING WORKSHEET

ENGINE No.____________ MAKE/YEAR ______________ DISTRIBUTOR No.__________

CONDENSER (if applicable)			GOOD	BAD
Series Leakage	spec BLACKBAND IN OUT		☐	☐
Leakage	spec BLACKBAND IN OUT		☐	☐
Capacity	spec ________MFD	Measured ________MFD	☐	☐
PULSE GENERATORS				
Reluctor Condition	VISUAL		☐	☐
Pickup Coil Condition	VISUAL		☐	☐
Pickup Coil Resistance	spec ____________	Measured ________Ohms	☐	☐
Pulse Generator Ground Short	spec (infinity)	Measured ____________	☐	☐
Air Gap (if applicable)	spec ____________	Measured ____________	☐	☐
DISTRIBUTOR – MECHANICAL COMPONENTS				
Cylinder Timing Accuracy	spec ± 1°	Measured ____________	☐	☐
Bushings, shaft				
Breaker plate condition	VISUAL INSPECTION		☐	☐
MECHANICAL ADVANCE				
Starting point	spec ____________	Measured ____________	☐	☐
Low	spec ______° @ ______	Measured ______°	☐	☐
Intermediate	spec ______° @ ______	Measured ______°	☐	☐
High speed	spec ______° @ ______	Measured ______°	☐	☐
Mech. Spark retard	Returns to zero		☐	☐
VACUUM ADVANCE				
Vac. Chamber leak	**HOLDS VACUUM**		☐	☐
Vac. Plate action	VISUAL INSPECTION		☐	☐
Starting point	spec ______" @ ______	Measured ______"	☐	☐
Low vacuum	spec ______° @ ______	Measured ______°	☐	☐
Intermediate vacuum	spec ______° @ ______	Measured ______°	☐	☐
High vacuum	spec ______° @ ______	Measured ______°	☐	☐
VAC Spark retard	Returns to zero		☐	☐

NAME: ____________________

DATE: ____________________

DISTRIBUTOR TESTING QUIZ

1. Excessive drop in dwell as distributor speed is increased may indicate

   A. Point bounce
   B. Point float
   C. Poor condenser ground
   D. All of the above

2. The contact point resistance test using the dwell meter on the distributor machine will check the electrical condition of

   A. Ignition breaker points
   B. Pigtail lead
   C. Connections
   D. All of the above

3. The typical automotive distributor turns at

   A. One-half crankshaft speed
   B. Twice crankshaft speed
   C. Three times crankshaft speed
   D. Four times crankshaft speed

4. Extra arrows on the degree ring of the distributor tester indicate

   A. Point float
   B. Point bounce
   C. Both of the above
   D. Neither of the above

5. Distributor advance mechanisms that provide improper timing may cause

   A. Ineffective emission control
   B. Poor M.P.G.
   C. Possible high speed miss
   D. All of the above

6. A condenser should be tested for

   A. Series resistance
   B. Electrical capacity
   C. Electrical leakage
   D. All of the above

7. A distributor tester can be a real help when diagnosing gasoline milage complaints.

   True   False

DISTRIBUTOR TESTING QUIZ (con't.)

8. Ignition breaker points can be made to give longer service if they are properly aligned when they are installed.

   True False

9. The chance of customer comebacks due to distributor problems may be reduced significantly and profits increased when distributors are removed from the engine and thoroughly cleaned, serviced and adjusted.

   True False

10. The distributor vacuum advance diaphragm is most easily checked for pinhole leaks by using the vacuum pump of the distributor machine.

    True False

11. The pickup coil must be tested for continuity and resistance.

    True False

12. To properly trigger the Distributor Tester when testing most electronic distributors, a pulse amplifier is not needed.

    True False

13. On electronic ignition systems, mechanical and vacuum advance are checked in the same manner as standard ignitions.

    True False

14. On all electronic ignition systems the air gaps are adjustable.

    True False

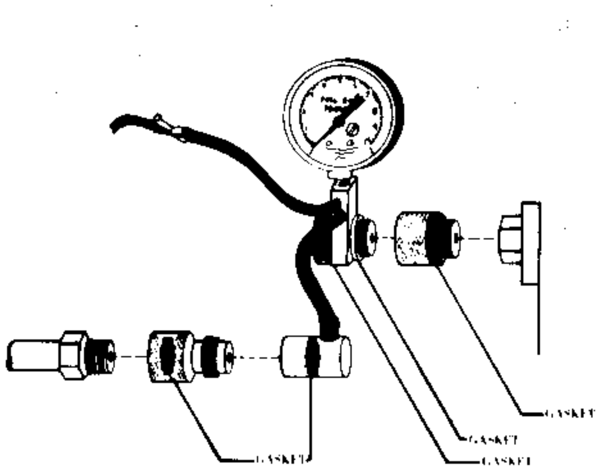
15. When testing the Prestolite electronic distributor on the Distributor Tester, an external battery must be used.

    True False

FUEL PUMP TESTER

The Fuel Pump Tester is used to measure the pressure and volume of fuel delivered to the carburetor. It tests the effectiveness of the fuel pump, the ability of the fuel lines to carry the fuel from the tank to the pump, the venting system of the fuel tank and the ability of the carburetor's needle valve to shut off the flow of fuel in the float bowl.

The fuel pump tester uses a gauge assembly, a graduated fuel container and adapters to allow the tester to be used on various carburetors with both screw in fittings and slip on hose fittings.

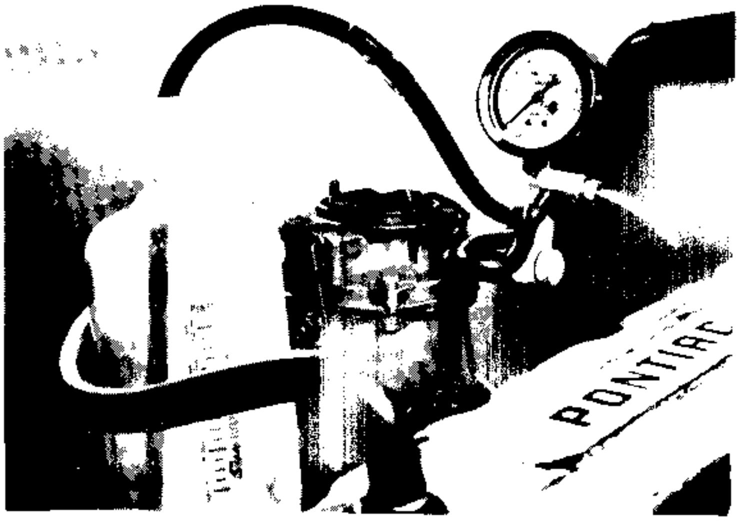


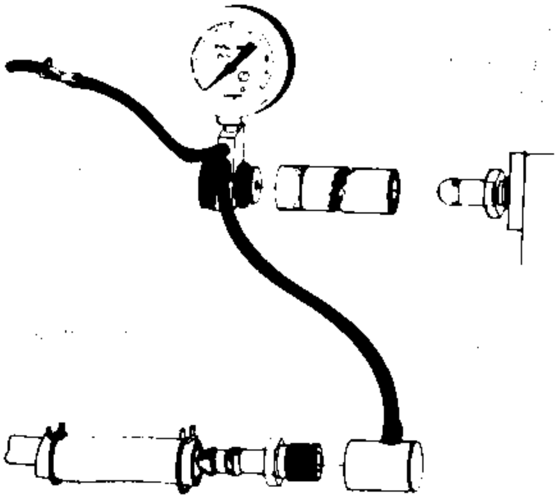
DETAIL TESTS

FUEL PUMP VOLUME

Make this test to determine if the fuel system can deliver the proper volume of fuel to the carburetor. This test should be done before pressure tests.

1. Remove the fuel line from the carburetor fitting.
2. Attach the FUEL PUMP TEST GAUGE to the carburetor's body. Use adapters as required. threaded adapters (top), no adapters (center), and flexible hose (bottom).
3. Connect the vehicle's fuel line to the FUEL PUMP TESTER'S hose. Use adapters as required. Tighten finger tight.
4. Close the shut off clamp on the tester's VOLUME HOSE.
5. Start engine and run at specified test RPM for the Fuel Pump Volume Test.
6. Put the end of the Volume Hose down to the bottom of the graduated container and open the clamp.
7. Record the time to pump the specified amount into the container. Watch for air bubbles in the fuel.
8. Close the clamp.





See results after FUEL PUMP PRESSURE testing

FUEL PUMP PRESSURE

Make this test to determine if the fuel system can deliver the fuel at the proper pressure to the carburetor. Always run the volume test before the pressure test to flex the fuel pump's diaphragm so the pump will supply its full pressure during test.

1. Set engine to specified test RPM for fuel pump pressure test.

2. Record pressure on gauge.

Results of volume and pressure test.

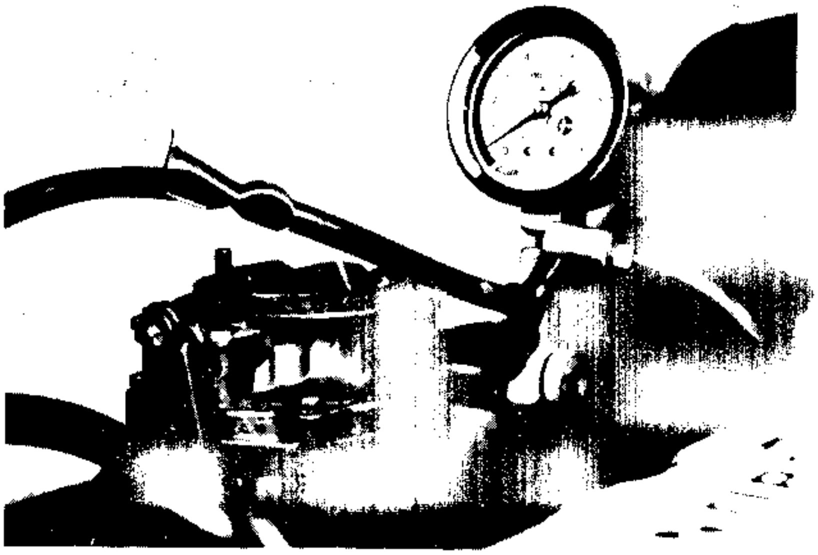
GOOD Volume and pressure within specifications.

BAD Volume and Pressure low indicates a defective pump or a restricted or leaking fuel line.

Volume good but Pressure is low indicates a defective pump (the pressure spring is weak).

Volume low but Pressure is good indicates a restricted or leaking fuel line or a defective pump (pump stroke too short, cam lobe or pump lever arm is worn).

Excessive bubbles in fuel indicates a leak in the fuel line between the pump and the fuel tank.



CARBURETOR NEEDLE AND SEAT/FUEL PUMP CHECK VALVE TEST

Make this test to determine if needle valve in carburetor or check valve in fuel pump are leaking when engine is not running.

1. Run fuel pump pressure test, note pressure.

2. Stop engine and watch pressure gauge for 30 seconds.

GOOD Fuel pump pressure remains within specifications.

BAD If the fuel pressure drops quickly toward zero this indicates problems in carburetor needle valve or fuel pump check valve.

Some vehicles with factory air conditioning may have a bypass fuel return line which will allow pressure to quickly drop to zero when the engine is stopped. These pumps may be identified by having an extra fuel line to return some of the fuel to the tank during operation.

FLOAT NEEDLE/FUEL PUMP CHECK VALVE TEST

Make this test to pinpoint the location of the loss of pressure between the fuel pump valves and the carburetor's needle and seat.

1. Start engine and wait until pressure builds to specification.

2. Pinch off hose between vehicle fuel line and test gauge.

3. Stop engine and watch gauge for 30 seconds.

RESULTS If pressure now holds steady then the check valve in fuel pump is leaking.

If pressure drops quickly toward zero then the problem is the carburetor needle and seat.

NAME ____________________
DATE ____________________

FUEL SYSTEM TESTING WORKSHEET

Eng. No. ____________________ Make/Year ____________________

GOOD BAD

FUEL PUMP TESTING

Volume
(within specifications)
Spec __________ amount __________ Measured ______________ ☐ ☐

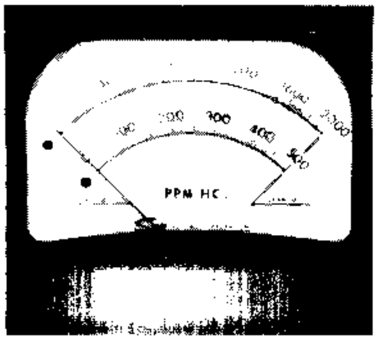
Pressure
(within specifications)
Spec __________ PSI Measured ______________ ☐ ☐
(holds pressure with engine stopped) Measured ______________ ☐ ☐

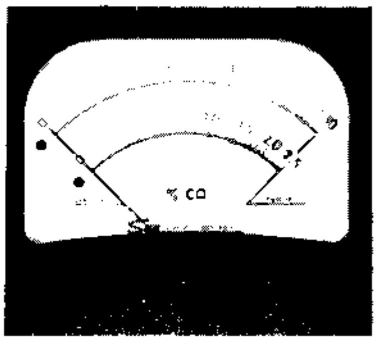
Vacuum
(within specifications)
Spec __________ inches Measured ______________ ☐ ☐

EXHAUST EMISSION TESTER

The Infra-Red Exhaust Emission Tester is used to quickly indicate how well an engine is running. It also serves as a carburetor adjustment and testing tool, a PCV system tester and a leak tester.

The Infra-Red Tester measures the amount of Hydrocarbons (HC) and Carbon Monoxide (CO) in a sample of exhaust gas. Hydrocarbons are unburned gasoline and Carbon Monoxide is a gas produced during combustion. The HC meter reads parts-per-million (PPM) of Hydrocarbons and the CO meter reads percent (%) of Carbon Monoxide.

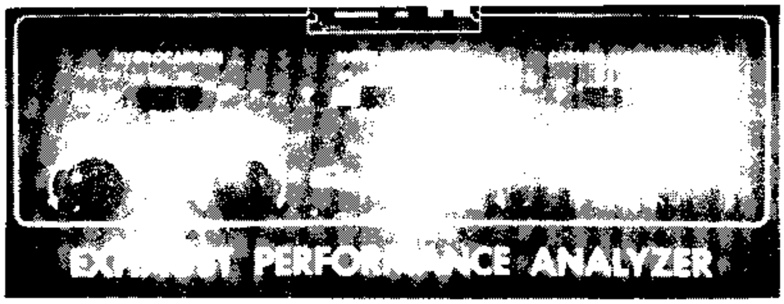




The level of Hydrocarbons is affected by misfiring and compression losses. A misfiring cylinder dumps a charge of unburned gasoline (HC) into the exhaust and raises the HC reading.

METERS AND CONTROLS

HYDROCARBON METER	**Reads in parts per million (PPM)**
CARBON MONOXIDE METER	Reads in percent (%)
MODE CONTROL	Pushbuttons to select test or calibrate modes, or to turn tester off.
READ OUT CONTROLS	For each meter
Hi-Lo Push Buttons	For meter scale range selection. (Indicator lights on meters identify scale to be read.)
Zero and Span Knobs	For Zero Set and Span Set calibration
OVERLOAD PROTECTION	Circuit breaker located on rear of cabinet



CALIBRATION AND WARM-UP

1. With tester connected to proper power source (refer to tester nameplate), depress "Zero" mode control button and allow tester to warm up for 5 minutes.

2. Adjust "Zero" knobs below meters until both meter pointers read "Zero Set".

3. Depress and hold "Span" mode control button while adjusting "Span" knobs below meters until both meter pointers read "Span Set".

4. Release "Span" button and recheck "Zero" adjustment.

NOTE: During first 15 minutes of operation, tester may require slight additional calibration adjustments. Calibration can be checked at any time by repeating steps above. It is not necessary to remove sample probe from tailpipe or to stop vehicle engine to recheck calibration of tester.

TESTING PROCEDURE

1. Select "Hi" scale range of both meters.

2. Insert sampling probe into vehicle tailpipe.

3. Depress "Test" mode control button.

4. Warm test engine to normal operating temperature.

5. Operate engine at desired test speed and note and record readings of both meters.

NOTE: Run engine at fast idle for 30 seconds before taking a reading to clear out excessive fuel from the engine.

6. If exhaust performance tests are to be conducted at more than one engine speed, readjust engine speed as necessary and repeat Step 5 above.

7. When tests are concluded, push "Zero" button and remove sample probe from vehicle tailpipe.

CARBURETOR SETTING AND TESTING (IDLE)

The compression and ignition system must be working properly before starting carburetor adjustments.

HC Testing and Adjustment

1. Connect the sample hose to the vehicle's exhaust pipe.
2. Connect tachometer pick-up.
3. Check calibration of the tester.
4. Warm engine to normal operating temperature.
5. Run engine at a fast idle (1500-2000 RPM) for 30 seconds to clear out excessive fuel from engine.
6. Measure HC at idle.

   GOOD The HC is below specifications; or less than 300 PPM for emission controlled vehicles, or less than 500 PPM for non-emission controlled vehicles. Proceed to carburetor adjustment.

   BAD The HC is above specifications; the engine has a misfire due to ignition or compression problems not corrected during service. Before condemning, however, set the idle mixture to a slightly richer mixture to be sure problem is not over lean mixture misfire. If HC cannot be brought in to specifications, the misfire causing problem must be corrected before adjusting carburetor.

HC and CO Testing and Adjustment

Set idle mixture. Whenever they are available, follow the manufacturer's instructions for carburetor adjustment. If the manufacturer's instructions are not available this procedure may be followed:

INFRA-RED TESTER

1. Back out the idle-mixture screws equally, from a lightly seated position, to get a rich mixture.
2. Start the engine and set initial idle speed.
3. Lean the mixture by turning the idle-mixture screws equal amounts. Hold idle RPM. Wait for the CO and HC readings to stabilize each time. (It takes about 7 seconds from the time you change something in the engine for the results to show up on the meters.)
4. Read CO and HC meters.

   GOOD CO within specification indicates the fuel mixture is correct and no components are adversely affecting the burning process. HC did not increase and is within specifications; indicates that no misfiring is occurring due to undetected ignition or compression problems and mixture has not been set overly lean.

   BAD CO cannot be brought into specifications, check for internal carburetor problems, sticking choke or improper timing. HC above specifications, check for ignition or compression problems. If HC went up during adjustment try enriching mixture slightly. If the HC then goes down the mixture is too lean at idle. Check manufacturer's literature or service manuals for recommended changes to correct this lean misfire.

ACCELERATOR PUMP TEST

This procedure determines if the accelerator pump supplies sufficient additional fuel to prevent flat spots or stumble under both light and heavy acceleration.

1. Connect a vacuum gauge to a source of manifold vacuum.
2. Briefly open the throttle slightly to cause the vacuum to decrease about 2-3 inches (light acceleration). Read CO meter.

3. Open throttle briefly to obtain a large decrease in vacuum (hard acceleration). Read CO meter.

   GOOD On both tests the CO meter does not initially indicate any leaner mixture (lower CO) and the CO increases at least 0.5% (light acceleration) and over 1% on hard acceleration.

   BAD An initial decrease in CO, or a failure to show the specified increase indicates problems in the accelerator pump circuit. Check the accelerator's pump stroke, the linkage, plunger, check valves, etc.

CRUISE SPEED CARBURETOR TESTING

Run the engine at 2500 RPM. Read the CO and HC meter.

GOOD The CO is equal to or lower than at idle. HC is equal to or lower than at idle.

BAD Higher CO indicates carburetor or fuel system problems.

Check float level, needle and seat, for dirt in carburetor jets or air bleeds, excessive fuel pressure, proper choke action, and proper timing advance.

High HC indicates ignition or compression problems.

High CO and HC indicate problems in ignition, compression or fuel system. Completely test the engine to determine which components require service.

NOTE: Some vehicles with fuel injection will not test accurately at 2500 RPM under no-load conditions. Testing of these vehicles at 2500 RPM should be done under load, such as on a chassis dynamometer.

PCV TESTING WITH THE CO METER

Follow this procedure to determine if the PCV system is functioning properly.

1. Remove the PCV valve from the engine but don't disconnect the hose that leads from it to either the carburetor or intake manifold.

2. Plug the open end of the valve. Read the CO meter.

   GOOD The CO increases.

   BAD The CO remains the same or increases only slightly. This indicates the PCV valve or the hose is plugged.

GO/NO-GO TESTING

This test is a way of inspecting a complete engine system quickly. An engine that fails to pass this test for CO, HC or idle speed needs further testing and service.

NOTE: The specifications given here are not tune-up or legal limits, but rather guide lines you may use to detect vehicles which require service. Be aware that some vehicles may pass these limits and still require service. In cases of customer complaints of engine performance we suggest you follow a Complete Engine Performance Test Procedure which includes an emission test.

1. Connect sample hose to vehicle's exhaust pipe.
2. Connect tachometer pickup.
3. Check tester calibration.
4. Warm the engine to normal operating temperature.
5. Run the engine at a fast idle (1500-2000 RPM) for 30 seconds to clear out excessive fuel in the engine.
6. Record HC and CO at idle.
7. Record idle RPM.
8. Increase engine speed to 2500 RPM, record HC and CO.

   GO The HC and CO within specification (see below) at idle and both readings lower during 2500 RPM test. Idle speed within specifications.

NO/GO The HC and/or CO are higher than specifications at idle or if either one increases at 2500 RPM, or idle not at specified RPM.

NOTES:

1. If HC is out of specification, the vehicle requires further testing to determine the cause of misfiring before service recommendations can be made.

2. If idle speed is incorrect, reset to specified RPM and repeat CO tests.

3. If idle speed is readjusted and CO is out of specification, readjust idle mixture. If CO cannot be brought into GO/NO-GO specifications, vehicle requires additional testing and/or service.

4. Some vehicles with fuel injection will not test accurately at 2500 RPM under no load conditions. Testing of these vehicles at 2500 RPM should be done under load, such as on a chassis dynamometer.

CO and HC SPECIFICATIONS FOR GO/NO-GO TESTING

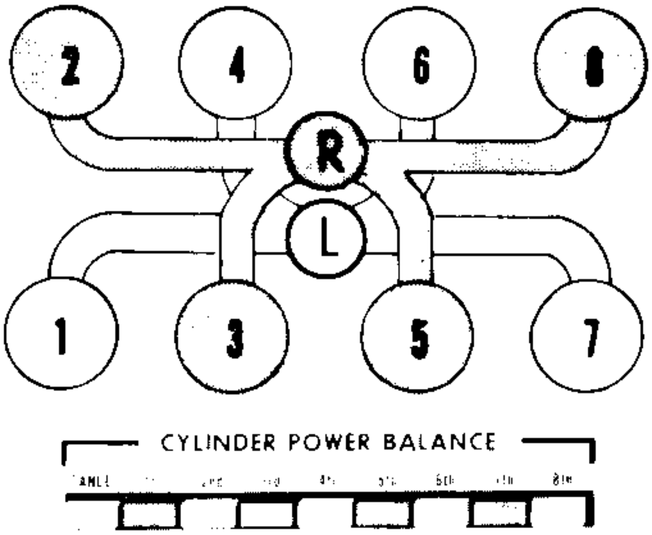
Emission controlled vehicles @ idle RPM:

CO less than 3% HC less than 400 PPM

Non-emission controlled vehicles @ idle RPM:

CO less than 6% HC less than 900 PPM

The most efficient and accurate method of adjusting carburetor idle mixtures on-the-vehicle is by following the "Odd and Even" balance procedure described below. This procedure works well on most standard production V-8 engines which are equipped with an intake manifold that has intake passages routed as illustrated. This procedure will not work on engines with single plane manifolds such as the 1977 G.M. 301 and 305 cu. in. engines with 2 barrel carburetors, the 1977-425 Cadillac engine, the 1970-71 Chrysler 318 cu. in. engine, and others. On these engines, fuel is distributed to all cylinders from both barrels of the carburetor.



FIRING ORDER: 1 8 4 3 6 5 7 2

TEST PROCEDURE

1. Identify each engine cylinder by number on an engine chart as illustrated. Cylinder numbers are identified on Sun Specification Cards and in manufacturer's engine service manuals.

NOTE: The cylinders are numbered like many American Motors, Chrysler and General Motors engines. One, three, five and seven are in the left bank, and two, four, six and eight are in the right bank, and fire in the sequence of 1, 8, 4, 3, 6, 5, 7, 2. By writing the firing order in the space provided below the Power Balance push buttons on the diagram, it can be readily seen that depressing the odd numbered push buttons will short out the four cylinders (1, 4, 6 and 7) being fed from the left barrel of the carburetor. On the other hand, if the evenly numbered push buttons are depressed, the cylinders fed by the right barrel (2, 3, 5 and 8) will be shorted out.

2. Run the engine at idle speed.

3. Short out the "even" half of the cylinders and note the engine RPM. The Power Balance function of the tester is used for this test. The Power Balance Test has been explained previously.

CAUTION: On vehicles equipped with catalytic converters, do not run for more than 20 seconds at a time with four cylinders shorted.

4. Short out the "odd" half of the cylinders and note the engine RPM.

5. Compare these engine speeds.

RESULTS AND INDICATIONS

Engine speeds taken from each side of carburetor are within 10 RPM of each other - indicates a balanced carburetor.

Engine speeds taken from each side of carburetor are not within 10 RPM of each other - indicates an unbalanced carburetor.

ADJUSTMENT PROCEDURES

If the carburetor is out of balance, a considerable difference in RPM will be noted when comparing the operation of one carburetor barrel with the other. If the engine does not run at the same RPM on each side of the carburetor, determine if there is a problem other than carburetor adjustment causing the unbalance, using normal testing methods.

To correct an unbalanced carburetor condition, the "odd" and "even" balance method provides an accurate means of matching the adjustment of the mixture settings as follows:

1. Adjust the idle mixture settings to produce an even RPM drop from each barrel of the carburetor.

2. After the two sides are in proper balance, use the Sun Infra-Red Exhaust Emission tester to adjust the carburetor to factory specifications by adjusting both mixture screws equally.

NOTE: If it is impossible to balance idle mixture adjustments in this manner, carefully test engine, check cylinder and manifold conditions, and completely test all ignition system functions in the usual manner, for it will be impossible to balance and adjust the carburetor if engine, manifold or ignition system malfunctions exist.

FUEL SYSTEM QUIZ

1. CO (carbon monoxide) is affected by which two answers:

   A. Fuel mixture and ignition timing
   B. Misfiring of one or more cylinders
   C. Choke operation and carburetor preheater controls

2. An increase in HC as the idle mixture is leaned out indicates:

   A. Bad spark plugs or spark plug wires
   B. Improper timing
   C. Mixture is too lean
   D. Choke is sticking

3. Proper accelerator pump action should show an enrichment of:

   A. 3.0% CO
   B. No change
   C. 1.0% CO
   D. .01% CO

4. When the PCV valve is pinched closed the:

   A. % CO will drop
   B. % CO will increase
   C. HC will drop to zero
   D. CO will drop to zero

5. An increase in CO will always be followed by:

   A. A decrease in HC
   B. An increase in HC
   C. No change in HC
   D. None of these

6. Fuel injected engines at 2500 RPM under "no load conditions" will always:

   A. Have low CO, high HC
   B. Have high CO, low HC
   C. No change in HC or CO
   D. None of these

7. Valid fuel pump pressure and volume measurements should be made within 6" of:

   A. Fuel tank
   B. Fuel pump
   C. Fuel line
   D. Carburetor

8. A restricted or crimped fuel line from the tank to the fuel pump would cause:

   A. Low pressure and low volume
   B. High pressure and low volume
   C. Low pressure and high volume
   D. Low volume and no pressure change

9. If a fuel pump specification reads one quart in one minute, it could be changed to:

   A. 1 pint in 30 seconds
   B. 1 pint in 60 seconds
   C. 2 quarts in 30 seconds
   D. 4 quarts in 15 seconds

10. Air bubbles seen in the fuel during the volume test indicates:

   A. Air leak in the tank to fuel pump line
   B. Leaky fuel pump
   C. Internal leak in the carburetor
   D. A and B only

AREA AND DETAILED DIAGNOSTIC TESTING

SYSTEM	AREA TEST FAILURE	DETAILED TESTS USED TO DETECT COMPONENT FAILURE NOTE: Identifying component failure will result from doing the detailed tests listed.
STARTING	Cranking Voltage (Battery)	Complete VAT testing
	Starter Draw	Complete VAT testing
	Cranking Speed	Complete VAT testing
CHARGING	Alternator Peak (Amps)	Peak Test Speed Complete VAT Test Alternator Component Test SASC 1600 Test
	Alternator Condition	Complete VAT Test Stator Coil Test Ohmmeter Diode Test SASC 1600 Test
	Charging Volts	Complete VAT Test SASC 1600 Test
ENGINE MECHANICAL	Relative Compression	Compression Test Cylinder Leakage Test
	Cranking Vacuum	Compression Test Cylinder Leakage Test
	Idle Manifold Vacuum	Engine Speed Compression Test Cylinder Leakage Test
	Idle HC	Compression Test Cylinder Leakage Test Valve Timing Check
	Cruise Manifold Vacuum	Engine Speed Compression Test Cylinder Leakage Test
	Cruise HC	Same as Idle HC
	Cylinder Power Balance	Compression Test Cylinder Leakage Test
	Exhaust Restriction (Manifold Vacuum at High Cruise)	Engine Speed Compression Test Cylinder Leakage Test Visual Check Of Exhaust System
	High Cruise HC	Same as Idle HC

AREA AND DETAILED DIAGNOSTIC TESTING

SYSTEM	AREA TEST FAILURE	DETAILED TESTS USED TO DETECT COMPONENT FAILURE NOTE: Identifying component failure will result from doing the detailed tests listed.
IGNITION	Distributor Resistance (Dynamic And Static)	Voltage Drop Test
	Cranking Dwell	Idle Dwell
	Cranking Coil Output	Coil Output Test Primary Circuit Resistance Bypass Circuit Test Breaker Point Condition Dwell Test Ignition Coil Bench Test Condenser Bench Test
	Idle Speed	Use Tachometer to Adjust
	Idle Dwell	Cruise Dwell Dwell Variation Use Dwell Meter to Adjust
	Idle HC	Engine Speed Initial Timing Vacuum Advance Systematic Grounding Test Systematic Insulation Test Primary Circuit Resistance
	Idle CO	Ignition Timing
	Idle Manifold Vacuum	Initial Timing Idle Speed Advance Curve Tests
	Initial Timing	Check Firing Order (Visual) Dwell Idle Speed Use Timing Light to Adjust
	Spark Plug Firing Voltage (Ignition Secondary Max.)	Systematic Grounding (Check plugs, plug wires, distributor cap and towers, rotor, coil wire.) Check Plug Gap
	Spark Plug Firing Voltage (Ignition Secondary Min.)	Secondary Insulation (Check plug, wire, distributor cap and rotor.) Check Plug Gap
	Coil Polarity	Visual Check of Coil and Battery Voltmeter Polarity Check of Battery

AREA AND DETAILED DIAGNOSTIC TESTING

SYSTEM	AREA TEST FAILURE	DETAILED TESTS USED TO DETECT COMPONENT FAILURE NOTE: Identifying component failure will result from doing the detailed tests listed.
IGNITION (con't.)	Coil Output (Max.)	Dwell Primary Circuit Resistance Ignition Coil Bench Test Condenser Bench Test
	Secondary Insulation	Visual Check for Carbon Tracks or Pin Holes Systematic Insulation Test
	Secondary Resistance Test (Secondary Circuit Condition)	Systematic Grounding (Check plugs, wires, distributor cap, and coil wire.) Ohmmeter Secondary Wires
	Coil and Condenser (Oscilloscope)	Dwell Primary Circuit Resistance Ignition Coil Bench Test Condenser Bench Test
	Breaker Point Condition	Dwell Condenser Bench Test Bypass Circuit Primary Circuit Resistance Distributor Resistance Test Distributor Tester
	Cam Lobe Accuracy	Distributor Tester
	Cruise HC	Same as Idle HC
	Cruise CO	Same as Idle CO
	Cruise Manifold Vacuum	Initial Timing Advance Curve Tests
	Cylinder Power Balance	Distributor Tester Systematic Grounding Test Visual Check for Carbon Tracks or Pin Holes Systematic Insulation Test Coil Bench Test
	Spark Plugs Under Load (Snap Acceleration KV)	Peak Test Speed Ohmmeter Secondary Wires Check Plug Gaps Systematic Insulation Test
	High Cruise Speed	Primary Circuit Resistance Secondary Circuit Resistance

AREA AND DETAILED DIAGNOSTIC TESTING

SYSTEM	AREA TEST FAILURE	DETAILED TESTS USED TO DETECT COMPONENT FAILURE NOTE: Identifying component failure will result from doing the detailed tests listed.
IGNITION (con't.)	High Cruise Dwell	Distributor Tester
	Dwell Variation	Distributor Tester
	Timing Advance	Centrifugal Advance Vacuum Advance Dwell Idle and Cruise Speed Initial Timing Distributor Tester
	High Cruise HC	Same as Idle HC
	High Cruise CO	Same as Idle CO
FUEL	Idle HC	Engine Speed Check Choke Circuit Fuel Pump Check Carburetor Balance Test Vacuum Leakage Test
	Idle CO	Check for Dirty Carburetor Visual Check of Primary Jets Visual Check of Power Valve Torque Carburetor Bolts Check Choke Circuit Engine Speed Fuel Pump Check Check Float Circuit Air Cleaner Check
	Cruise HC	Tests Same as Idle HC Check Main Metering Circuit
	Cruise CO	Tests Same as Idle CO Check Main Metering Circuit
	Accelerator Pump Action (Snap Acceleration CO)	Measure Float Level Torque Carburetor Bolts Visually Check Pump Cup and Circuit
	High Cruise HC	Tests Same as Idle HC
	High Cruise CO	Tests Same as for Idle CO Check Main Metering Circuit
	Cylinder Power Balance	Carburetor Balance Test Check for Dirty Carburetor Adjust Carburetor to Specifications

AREA AND DETAILED DIAGNOSTIC TESTING

SYSTEM	AREA TEST FAILURE	DETAILED TESTS USED TO DETECT COMPONENT FAILURE NOTE: Identifying component failure will result from doing the detailed tests listed.
EMISSION CONTROLS	Idle Speed	Carburetor Dashpot Choke System Distributor Tester
	Idle Manifold Vacuum	Emission Systems Function Tests
	PCV Test	PCV Vacuum Test PCV CO Test
	Idle HC	Vacuum Leakage Test Air Injection System Test Catalytic Converter Test
	Idle CO	Check Heat Riser Valve System Vacuum Leakage Test Emission Systems Function Test
	Cruise Manifold Vacuum	Emission Systems Function Test
	Cruise HC	Same as Idle HC
	Cruise CO	Same as Idle CO
	High Cruise HC	Same as Idle HC
	High Cruise CO	Same as Idle CO
	Timing Advance	Distributor Tester
	Cylinder Power Balance	EGR System Emission Systems Function Tests

NAME ____________________
DATE ____________________

GENERAL MOTORS CORPORATION EMISSION CONTROL SYSTEMS

Make ______________ Year ____________ No. of Cyl. ________ Cu. In. ________
Mileage ________________ Ignition Type ______________ Trans. ______________

Code as follows: Good X Requires repair ○ Repairs completed ⊗

POSITIVE CRANKCASE VENTILATION	OK	SERVICE	REPLACE
1. PCV Valve			
2. Inlet Air Filter			
3. PCV Hoses			

EVAPORATION CONTROL SYSTEM	OK	SERVICE	REPLACE
1. Pressure-Vacuum Cap			
2. Canister Filter			
3. Hoses And Connections			
4. Carburetor Bowl Vent			
5. Purge Valve			

CARBURETOR CONTROLS	OK	SERVICE	REPLACE
1. Choke System			
a. Vacuum Break Unit			
b. Auxiliary Vacuum Break			
2. Warm-Up Control Systems			
a. (EFE) Early Fuel Evaporation Valve			
b. EFE Thermal Vacuum Switch			
c. EFE Check Valve			
d. EFE Control Solenoid			
e. EFE Oil Temperature Switch			
3. Thermostatic Air Cleaner			
a. Air Cleaner Filter			
b. Thermac Motor			
c. Thermac Sensor			
d. Heated Air Hoses			
e. Air Hoses And Connections			
f. Door Control			

GENERAL MOTORS CORPORATION EMISSION CONTROL SYSTEMS (con't.)

	OK	SERVICE	REPLACE
4. Engine Speed			
a. Dashpot			
b. Idle Stop Solenoid			
c. Distributor Controls			

DISTRIBUTOR CONTROLS	OK	SERVICE	REPLACE
1. Trans. Controlled Spark (TCS) Switch			
2. Spark Delay Valve			
3. Thermal Vacuum Switch			
4. Spark Coolant Temp. Override Switch			
5. Vacuum Advance Modulator Valve			

EXHAUST GAS CONTROLS	OK	SERVICE	REPLACE
1. Exhaust Gas Recirculation System			
a. EGR Valve			
b. EGR Hose And Connections			
c. EGR Back Pressure Transducer			
d. EGR Delay Valve			
e. EGR Thermal Vacuum Valve (TVV)			
f. EGR Thermal Vacuum Switch (TVS)			
g. EGR Thermal Control Valve (TCV)			
2. Catalytic Converter System			
a. Catalytic Converter			
b. Exhaust Pipes			
c. Heat Shields			
3. Air Injector System			
a. Air Injector Pump			
b. Pump Filter			
c. Air Injector Drive Belt			
d. Air Injector Diverter Valve			
e. Air Injector Check Valve			
f. Hoses And Connections			

NAME ______________________
DATE ______________________

FORD MOTOR COMPANY EMISSION CONTROL SYSTEMS

Make ________________ Year ____________ No. of Cyl. ________ Cu. In. __________
Mileage __________________ Ignition Type ________________ Trans. ________________

Code as follows: Good X Requires repair ○ Repairs completed ⊗

POSITIVE CRANKCASE VENTILATION	OK	SERVICE	REPLACE
1. PCV Valve	______	______	______
2. Inlet Air Filter	______	______	______
3. PCV Hoses	______	______	______

EVAPORATION CONTROL SYSTEM	OK	SERVICE	REPLACE
1. Pressure-Vacuum Cap	______	______	______
2. Canister Filter	______	______	______
3. Hoses And Connections	______	______	______
4. Carburetor Bowl Vent	______	______	______

CARBURETOR CONTROLS	OK	SERVICE	REPLACE
1. Choke Systems			
a. Electric Assist Choke Switch	______	______	______
b. Electric Assist Choke Element	______	______	______
c. Assist Choke AC Source (Alternator)	______	______	______
d. Choke Pulldown Valve	______	______	______
2. Warm-Up Control System			
a. Vacuum Heat Control Valve (HCV)	______	______	______
b. HCV Vacuum Motor	______	______	______
c. HCV Ported Vacuum Switch	______	______	______
3. Thermostatic Air Cleaner			
a. Air Cleaner Filter	______	______	______
b. Vacuum Motor	______	______	______
c. Temperature Sensor	______	______	______
d. Heated Air Hoses	______	______	______
e. Thermostat Control	______	______	______
f. Auxiliary Air Inlet Valve	______	______	______

FORD MOTOR COMPANY EMISSION CONTROL SYSTEMS (con't.)

	OK	SERVICE	REPLACE
4. Engine Speed			
a. Dashpot			
b. Throttle Solenoid			
c. Distributor Controls			
d. Deceleration Valve			
e. Deceleration Solenoid			
f. Deceleration Transmission Switch			

DISTRIBUTOR CONTROLS	OK	SERVICE	REPLACE
1. Ported Vacuum Switch			
2. Spark Delay Valve			
3. Check Valve			
4. Dist. Retard Control Valve (DRCV)			
5. Spark Control Valve			
6. Temperature Switch			
7. Latching Relay			
8. Cold Start Spark Advance Valve			

EXHAUST GAS CONTROLS	OK	SERVICE	REPLACE
1. Exhaust Gas Recirculation System			
a. EGR Valve			
b. EGR Hoses And Connections			
c. EGR Vacuum Amplifier			
d. EGR Ported Vacuum Switch			
e. EGR Check Valve			
2. Catalytic Converter System			
a. Catalytic Converter			
b. Exhaust Pipes			
c. Heat Shields			
3. Air Injection System			
a. Air Injection Pump			
b. Pump Filter Fan			
c. Air Injection Drive Belt			
d. Air Injection Diverter Valve			
e. Air Injection Check Valve			
f. Hoses and Connections			

NAME ____________________
DATE ____________________

CHRYSLER MOTORS CORPORATION EMISSION CONTROL SYSTEMS

Make ______________ Year ______________ No. of Cyl. __________ Cu. In. __________
Mileage ______________ Ignition Type ______________ Trans. ______________

Code as follows: Good X Requires repair ○ Repairs completed Ⓧ

POSITIVE CRANKCASE VENTILATION	OK	SERVICE	REPLACE
1. PCV Valve			
2. Inlet Air Filter			
3. PCV Hoses			

EVAPORATION CONTROL SYSTEM	OK	SERVICE	REPLACE
1. Pressure-Vacuum Cap			
2. Canister Filter			
3. Hoses And Connections			
4. Overfill Limiting Valve			
5. Carburetor Bowl Vent			

CARBURETOR CONTROLS	OK	SERVICE	REPLACE
1. Choke System			
a. Electric Assist Choke Switch			
b. Electronic Assist Heating Element			
c. Assist Choke AC Source (Alternator)			
d. Idle Enrichment Valve			
e. Coolant Switch (Idle Enrichment)			
2. Thermostatic Air Cleaner			
a. Air Cleaner Filter			
b. Heated Air Hoses And Connections			
c. Heated Air Vacuum Diaphragm			
d. Heated Air Thermostat			
e. Heated Air Door Control			
3. Engine Speed			
a. Dashpot (manual trans.)			
b. Throttle Position Solenoid			
c. Throttle Position Speed Switch			
d. Distributor Controls			

CHRYSLER MOTORS CORPORATION EMISSION CONTROL SYSTEMS (con't.)

DISTRIBUTOR CONTROLS	OK	SERVICE	REPLACE
1. Orifice Spark Advance Control Valve	______	______	______
2. OSAC Hoses And Connections	______	______	______
3. Distributor Advance Solenoid	______	______	______
4. Thermal Ignition Control Valve	______	______	______

EXHAUST GAS CONTROLS	OK	SERVICE	REPLACE
1. Exhaust Gas Recirculation System			
a. EGR Valve	______	______	______
b. EGR Hoses and Connections	______	______	______
c. EGR Amplifier	______	______	______
d. EGR Coolant Control (CCEGR) Valve	______	______	______
e. EGR Time Delay Solenoid Valve	______	______	______
f. EGR Reminder Switch	______	______	______
g. EGR Reminder Indicator Lamp	______	______	______
2. Catalytic Converter System			
a. Catalytic Converter	______	______	______
b. Exhaust Pipes	______	______	______
c. Heat Shields	______	______	______
3. Air Injection System			
a. Air Injector Pump	______	______	______
b. Air Injector Fan Filter	______	______	______
c. Air Injector Drive Belt	______	______	______
d. Air Injector Diverter Valve	______	______	______
e. Air Injector Check Valve	______	______	______
f. Hoses And Connections	______	______	______

NAME ____________________
DATE ____________________

AMERICAN MOTORS CORPORATION EMISSION CONTROL SYSTEMS

Make ______________ Year ____________ No. of Cyl. __________ Cu. In. __________
Mileage ______________ Ignition Type ______________ Trans. ______________

Code as follows: Good X Requires repair ○ Repairs completed ⊗

POSITIVE CRANKCASE VENTILATION	OK	SERVICE	REPLACE
1. PCV Valve			
2. Inlet Air Filter			
3. PCV Hoses			

EVAPORATION CONTROL SYSTEM	OK	SERVICE	REPLACE
1. Pressure-Vacuum Cap			
2. Canister Filter			
3. Hoses And Connections			
4. Carburetor Bowl Vent			
5. Liquid Check Valve			

CARBURETOR CONTROLS	OK	SERVICE	REPLACE
1. Choke System			
a. Electric Assist Choke Switch			
b. Electric Assist Choke Element			
c. Assist Choke AC Source (Alternator)			
d. Modulator Diaphragm Assembly			
2. Thermostatic Air Cleaner			
a. Air Cleaner Filter			
b. Vacuum Motor			
c. Air Valve			
d. Thermal Sensor			
e. Heated Air Hoses And Connectors			
3. Engine Speed			
a. Dashpot			
b. Idle Stop Solenoid			
c. Distributor Controls			

AMERICAN MOTORS CORPORATION EMISSION CONTROL SYSTEMS (con't.)

DISTRIBUTOR CONTROLS	OK	SERVICE	REPLACE
1. Coolant Temp. Override Switch	______	______	______
2. Trans. Control Spark (TCS) Switch	______	______	______
3. TCS Solenoid Vacuum Valve	______	______	______

EXHAUST GAS CONTROLS	OK	SERVICE	REPLACE
1. Exhaust Gas Recirculation System			
a. EGR Valve	______	______	______
b. EGR Back Pressure Sensor	______	______	______
c. EGR Coolant Temp. Override Switch	______	______	______
2. Catalytic Converter System			
a. Catalytic Converter	______	______	______
b. Exhaust Pipes	______	______	______
c. Heat Shields	______	______	______
3. Air Injector System			
a. Air Injector Pump	______	______	______
b. Pump Filter	______	______	______
c. Air Injector Drive Belt	______	______	______
d. Air Injector Diverter Valve	______	______	______
e. Air Injector Check Valve	______	______	______
f. Hoses And Connections	______	______	______

STUDENT COMMENTS

SUN ELECTRIC CORPORATION
AUTOMOTIVE TESTING AND DIAGNOSIS COURSE

NAME
COMPANY
CITY
TITLE

SESSION 1 INTRODUCTION AUTOMOTIVE engine system and service quiz SERVICE CONTROL SYSTEM and procedures for handling customer engine service request Use of specifications and their meaning Use of Starting and Charging System Tester	COMMENTS
SESSION 2 COMPRESSION FACTORS Importance of compression factor testing Use of vacuum gauge, tachometer and dwell meter Use of cylinder balance testing Use of compression tester Use of cylinder leakage tester	COMMENTS
SESSION 3 IGNITION SYSTEM TESTING Importance of primary and secondary ignition system testing for good engine performance Ignition system theory Use of the voltmeter, ammeter, ohmmeter, condenser tester, coil tester, and oscilloscope	COMMENTS
SESSION 4 INTRODUCTION TO THE SUN SCOPE Importance of scope testing Development of the scope patterns Use of the scope to evaluate ignition systems	COMMENTS

SESSION 5

USING THE SUN SCOPE IN ENGINE TESTING

COMMENTS

Importance and value of systematic testing with the Sun Scope

Practical scope testing problems

Use of the scope in electronic ignition testing

SESSION 6

COMMENTS

DISTRIBUTOR TESTING

Importance of distributor testing

Use of distributor machine to test:
- Condensers
- Mechanical components
- Vacuum advance
- Contact points or pulse generators
- Mechanical advance

Use of Timing Light and Timing Advance unit

SESSION 7

COMMENTS

FUEL SYSTEM TESTING

Carburetion and fuel injection

Use of fuel pump tester

Use of Infra-Red exhaust gas tester

Introduction to exhaust emission controls

SESSION 8

COMMENTS

SUMMARY OF TOTAL COURSE

RELATION BETWEEN AREA AND DETAILED TESTING

Need for total vehicle testing

Review of SERVICE CONTROL procedures and systems

Practical testing of engines

GENERAL COMMENTS

SUN EET–947/945

ENGINE PERFORMANCE TEST REPORT

Customer Name ____________________ **Phone** ____________ **Date** ____________

Address ____________________ **City/State** ____________ **License** ____________

Make/Year/Model ____________________ **Mileage** ________ **Mileage Since Tune-Up** ________

Engine ____________ **Transmission—Auto** ☐ **Std** ☐ **Air Conditioning—Yes** ☐ **No** ☐

Carburetor ________ **Ignition Type** ________ **Air Pump—Yes** ☐ **No** ☐ **Converter—Yes** ☐ **No** ☐

Reason For Tests ____________________ **Tested By** ____________

TEST MODE	TESTS	READ	ENTER SPECIFICATIONS		TEST RESULT	GO	NO GO
#1 CRANKING	CRANKING VOLTAGE	VOLTMETER	VOLTS (MIN)				
	CRANKING COIL OUTPUT	SCOPE (DISPLAY)	KV (MIN)				
	CRANKING VACUUM	VACUUM GAUGE	STEADY				
#2 IDLE	IDLE SPEED	TACHOMETER	RPM				
	DWELL	DWELL METER	DEG				
	INITIAL TIMING	TIM-ADV. UNIT	DEG				
	HYDROCARBONS	HC METER	PPM				
	CARBON MONOXIDE	CO METER	%				
	PCV TEST	CO METER	%				
	MANIFOLD VACUUM	VACUUM GAUGE	INCHES				
#3 1500 RPM LOW CRUISE	DWELL VARIATION	DWELL METER	DEG				
	COIL POLARITY	SCOPE (DISPLAY)	VISUAL	▨			
	SPARK PLUG FIRING VOLTAGE	SCOPE (DISPLAY)	KV				
	MAXIMUM COIL OUTPUT	SCOPE (DISPLAY)	KV (MIN)				
	SECONDARY CIRCUIT INSULATION	SCOPE (DISPLAY)	VISUAL	▨			
	SECONDARY CIRCUIT CONDITION	SCOPE (RASTER)	VISUAL	▨			
	COIL AND CONDENSER CONDITION	SCOPE (RASTER)	VISUAL	▨			
	BREAKER POINT CONDITION	SCOPE (RASTER)	VISUAL	▨			
	CAM LOBE ACCURACY	SCOPE (SUPER)	VISUAL	▨			
	HYDROCARBONS	HC METER	PPM				
	CARBON MONOXIDE	CO METER	%				
#4 CYLINDER POWER BALANCE	ENGINE	TACHOMETER	BASE RPM				

		1	2	3	4	5	6	7	8
#4 CYLINDER POWER BALANCE	SHORTED RPM								

TEST MODE	TESTS	READ	ENTER SPECIFICATIONS		TEST RESULT	GO	NO GO
#5 SNAP ACCEL.	SPARK PLUGS UNDER LOAD	SCOPE (DISPLAY)	KV (MAX)				
	ACCELERATOR PUMP ACTION	CO METER	% (MAX)				
#6 2500 RPM HIGH CRUISE	TIMING ADVANCE	TIM.-ADV. UNIT	DEG				
	CHARGING VOLTAGE	VOLTMETER	VOLTS				
	HYDROCARBONS	HC METER	PPM				
	CARBON MONOXIDE	CO METER	%				
	EXHAUST RESTRICTION	VACUUM GAUGE	INCHES				

Sun DIAGNOSIS AND TRAINING GUIDE

ENGINE PERFORMANCE AND TESTING QUIZ

CORRECT ANSWERS

1. B
2. B
3. B
4. C
5. C
6. B
7. B
8. B
9. A
10. A
11. D
12. D
13. B
14. B
15. A
16. C
17. A
18. C
19. D
20. D
21. D
22. B
23. C
24. B
25. C
26. D
27. C
28. B
29. A
30. C
31. A
32. C
33. C
34. A
35. C
36. D
37. C
38. A
39. A
40. C

SPECIFICATION CARD WORKSHEET ANSWERS

1. 1975
2. Plymouth
3. 8 Cylinder
4. 360 Cu. In.
5. 2 BBL
6. Automatic
7. With
8. With
9. 013
10. 008-008A
11. 100 PSI
12. 40 PSI
13. CW
14. .008 inch
15. 400 to 600 ohms
16. 9.5 Volts Min.
17. 13.9 to 14.6 Volts @ 80° F
18. 20 KV Min.
19. 6° BTDC @ 750 RPM
20. 35° to 45°
    15° to 20° Cent. Only
21. 750 N
22. .3 @ 750 N
23. 5 to 7 PSI @ 750 N
24. 1 PT @ 30 Seconds @ 750 N
25. 140 to 210 PSI
26. 15,000 Mile
27. 1.602 to 1.79 ohms
28. 3 Amps
29. Exhaust Gas Recirculation
30. 17 to 27 Seconds
31. 225° F

SPECIFICATION CARD QUIZ ANSWERS

1. 1975
2. Vega
3. Four
4. 140 Cu. In.
5. 1 BBL
6. Auto. Trans.
7. With
8. With
9. 039
10. 038
11. 140 PSI
12. 20 PSI
13. CW
14. 830/750 DR
15. 100 to 140 Ft/Lb
16. 9 Volts
17. 55 Amp ± 10%
18. 13.4 to 14.4 Volts
    @ 125° F
19. Not Adjustable
20. 20 KV Min.
21. 10° BTDC @ 750 RPM
22. 31° to 35°
    7° to 9°
23. 750 DR Sol. En-er.
    550 DR Sol. De-en.
24. 3 to 4.5 PSI @ 12.6
    Volts Min.
25. 1 PT @ 30 to 45
    Seconds
26. 2.81 Lb. R-12
27. None

COMPRESSION SYSTEM TESTING QUIZ ANSWERS

1. B. Evaluate an Engine's General Compression Condition – An engine with good compression will have a fairly even cranking vacuum. A compression loss in one cylinder will cause the vacuum gauge to dip toward zero when that cylinder is cranked through its intake stroke.

2. B. Cylinder Balance or Unbalance Conditions – The vacuum gauge will indicate low compression in one or more cylinders that will cause an unbalance in power output. It will also indicate improper carburetion.

3. D. All of the Above – Compression losses will cause rough idle due to uneven power output from each cylinder. This engine will not fire the charge (air-fuel mixture) correctly in the bad cylinders, causing a miss. A serious compression loss may prevent a full charge from being drawn into the cylinder at cranking speed, thus giving you a hard starting condition.

4. D. Four – Watch the compression gauge while cranking the engine. Notice the pressure keeps building up as you crank it. Manufacturers have standardized 4 strokes for their specified cranking pressures.

5. B. Listen at various parts of the Engine – After connecting the air line, first listen at the carburetor (don't forget to pinch off the PCV hose), exhaust pipe and radiator. Then look at the gauge. This way you won't miss a leaking valve or head gasket that is only causing an 18% leak.

6. B. Intake and Exhaust Valves must be closed – You can run this test only when BOTH valves are closed.

7. D. A and B – By grounding the coil lead, you eliminate the possibility of the high voltage arcing to ground and damaging the coil tower or other secondary wiring during the cranking test. This also prevents the engine from accidentally starting during this test. Whenever you crank an engine over with a remote starter switch, always turn the ignition switch to ON to prevent damage to the switch. due to unusual circuits or antitheft devices. The coil high tension lead should then be grounded to prevent damage to the coil.

8. C. If a cylinder is not "pulling its share" you will see little or no drop in RPM. This test will show up compression problems, ignition problems affecting one or more cylinders and uneven carburetion problems.

9. A. Compression pressures are specified as the maximum pressure after four compression strokes, when cranking an engine with all the plugs out with a properly working starter and a fully charged battery. If any of these conditions aren't met, you may see low compression readings on all cylinders.

10. B. The narrowest place on many head gaskets and the most likely to "blow out" is between cylinders. If you hear air leakage in an adjacent cylinder look for head gasket problems.

ELECTRICAL TESTING QUIZ ANSWERS

1. B. Electrical Pressure – Voltage is the pressure that pushes current in an electrical circuit.

2. A. Electrical Current – Current is the flow of electricity.

3. C. Electrical Resistance – Ohm is the name of the unit of electrical resistance. It's like pinching a hose carrying water; when you close it off, you restrict the flow of water. This is what electrical resistance does; it restricts the flow of electricity. The higher the resistance, the more ohms, the less current will flow. So to have proper current, we must have proper resistance.

4. D. Electrical Capacity – Microfarad (Mfd.) is a unit of how much energy a condenser can store. Any further definition requires a knowledge of electrical theory.

5. C. 20,000 to 30,000 – The coil must put out at least 20,000 volts. When we study the scope, we'll learn that under conditions of heavy load, a spark plug might require up to 20,000 volts to fire. We want to be sure the coil can fire this plug under these conditions so we test the coil for a minimum of 20,000 volts output.

6. D. Distributor Rotor – The other secondary circuit components are: the distributor cap, the coil wire, coil secondary, the spark plug wires, and spark plugs.

7. A. Breaker Points – Other primary circuit components are the condenser, coil primary, primary circuit wiring, and the battery.

8. A. Should be Electrically Removed from the Circuit – Remove the part from the circuit to be sure you measure only the resistance of that component. During resistance measurements no battery power should be applied to the circuit, to prevent damage to the meter. The Ohmmeter used on the Sun engine tester is protected against this by an internal circuit breaker, but be careful with other Ohmmeters, you may burn them out.

9. B. In fact, if you suspect a coil is bad, test it on the vehicle. Occasionally, overtightening of the mounting clamp will cause a failure, but the same coil will pass when the clamp is loosened. Always test a new coil before installing it on the engine.

10. D. The pattern showed us the difference between good and bad coils. If the trace shows square corners on the oscillations, be sure that the pattern pickup is making good contact in the coil tower. Also look for corrosion or carbon in the coil tower.

ANSWERS FOR SCOPE QUIZ I

1. B. The vertical position of the trace indicates the voltage. The higher it is above the zero line, the higher the voltage.

2. D. Horizontal or sideways motion indicates time, measured in degrees of distributor rotation. We measure this time in Raster and Superimposed modes by means of the dwell scale below the zero line on the scope.

3. C. The condition and operation of the ignition system determines the changes in voltage in that system. The scope shows these voltages on the screen. If you see a good pattern, you know you have a good ignition system. This makes using the scope easy. All you need to learn is: (1) what is a good pattern (2) what components affect each portion of the trace. Put these together and you've pinpointed your trouble.

4. B. It may require up to 20 KV to fire the spark plugs on an engine under load. We test the coil to be sure it can deliver at least 20 KV so we won't have a misfire.

5. D. Bad points will show up on the scope in the secondary pattern's dwell section. During today's class we'll see how the Sun Scope can "see" the primary pattern and how point problems may also be seen here.

6. C. Excessive resistance will cause the spark lines to slope sharply downward.

7. D. Both A and B -- The scope is your tool to test the ignition system. It's the best way to find problems in ignition components and the only way to be certain of your work.

8. C. Dwell, Intermediate, Firing -- The firing section is where we see the plug fire and continue to arc. Here we see problems caused by engine conditions, fuel mixtures, plug gaps, plug conditions, plug wires, and the rotor gap. The intermediate section shows the action of the coil and condenser. The dwell section shows the points closing and opening. Here we see the condition of the contact points and the condenser.

9. D. Vary less than 3 KV and be 5 to 15 KV high -- There should be less than 3 KV difference in firing voltage between cylinders. Some of the newer exhaust emission controlled engines will have firing voltages up to 15 KV while pre-exhaust emission control engines may be as low as 5 KV.

10. Left to right C, A, B, D.
    C. Spark plugs and wires (spark lines).
    A. Coil and condenser (intermediate section).
    B. Points during closing (start of the dwell section).
    D. Points during opening (end of the dwell section).

ANSWERS TO SCOPE QUIZ II

1. C. Voltage and Time – The vertical position of the trace, the amount it's above the zero line, shows the voltage. The horizontal motion indicates the time in the ignition cycle, measured in degrees of distributor rotation.

2. B. Spark Line – The firing line shows the voltage required to first bridge the spark plug gap while the spark line shows the voltage required to keep the arc burning. Any "hash" on this line may be ignored. It's caused by turbulence within the cylinder. From a service standpoint, we as mechanics, can't change this turbulence, as it is a function of the design of the engine. Sometimes, at the end of the spark line, the voltage climbs up as high or even higher than the firing voltage. This is normal, as it's the remaining coil energy attempting to maintain its path to ground.

3. A. The end of the Dwell Section – The dwell section is the time from when the points close until they open.

4. B. Remove a Spark Plug Wire and hold it away from Ground – When the plug wire is held away from ground, the coil attempts to build voltage high enough to bridge this gap. If the gap is large enough, the coil will not be able to jump it and the voltage shown on the scope indicates the maximum output of the coil.

5. B. The Intermediate Section – This section shows the action of the coil and condenser while they are working together to use up energy left in the coil after the arcing stops. A faulty coil or condenser will cause the intermediate section oscillations to be distorted or to not be present.

6. C. Spark Plug - A bad plug, one with a wide or fouled gap, will show up during this test. When you load an engine by accelerating it, the firing voltage or amount of voltage it takes to jump the plug gap goes up. If the plug has a wider gap than it should, the firing voltage will go up higher. If the plug is fouled, the spark will go to ground through the fouling deposits and the firing voltage will go down. For this test, load the engine and watch the firing voltages. If they all go up a little, they're good. If one or more goes too high or goes down, you've got plug problems.

7. True We can see both the secondary and primary circuits. Primary is especially useful for looking at point problems.

8. True The spark line shows the effect of resistance in the secondary circuit. On an engine with solid (non-resistor) type wire, the spark line will be level. With resistor wire, it will have a slight slope. Excessive resistance will cause the line to slope sharply downward and be a little shorter than normal. Too low resistance, like a plug that's cracked, will show up as a level, very long spark line.

9. Bad Any loose connections, bad or damaged insulation is cause to replace plug wires.

10. Good For good starting, we should have over 20 KV coil output.

11. Good Look for the firing lines to go up, indicating correct coil polarity.

12. Bad More than 3 KV variation between cylinders.

13.	Good	Coil output GOOD. It's over 20 KV. Secondary insulation GOOD. There's a downwards spike.
14.	Bad	Look at the 4th cylinder, it's more than 3 KV higher than the lowest ones, the 3rd and 7th cylinders.
15.	Bad	On this 6 cylinder engine #5 and #4 have high resistance in the secondary circuit while #6 has low resistance.
16.	Bad	No oscillations in the intermediate section indicate problems in the coil or condernser.
17.	Bad	The spike at point close indicates the points opened again. Look for dirty or pitted points or bad spring tension.
		Point Opening, Bad – The hash here indicates arcing due to poor condenser action or badly pitted points.
18.	Good	Less than 2° difference at both point close and point open.
19.		Left to right: 5, 3, 6, 2, 4, 1
20.		Bottom to top: 1, 5, 3, 6, 2, 4

DISTRIBUTOR TESTING QUIZ ANSWERS

1. B. Point Float – When the points float they do not close at the proper time. This cuts down the total dwell period. You will normally see a sudden drop in dwell indicating that the points have started to float. See answer to question number 4.

2. D. All of the above – With the tester leads connected to the grounding stud and the end of the pigtail, all the distributor primary circuit is being tested (the pigtail lead, the terminations between the lead and the contact points, and the contact points themselves).

3. A. One-Half Crankshaft Speed – The distributor makes one revolution for every two crankshaft revolutions.

4. B. Point Bounce – The dwell period starts when the points close and ends when they open. If they bounce open after the start of the dwell section, we see an additional arrow on the tester and we know the coil has used up some of its energy and may not have enough left to fire the plug at the right time.

5. D. All of the Above – Improper advance will cause the exhaust emissions to be higher than normal due to incomplete burning of the fuel. It will also cause loss of power, which is usually compensated for by the driver by pushing down harder on the gas. And finally, incorrect total advance may cause detonation or knock at high speeds.

6. D. All of the Above – Capacity is the amount of energy the condenser can store, resistance is the amount of resistance to the flow of current in the condenser's pigtail lead and leakage is the amount of current that flows from one side of the condenser to the other.

7. True Only with the distributor tester can you be sure of the operation of the distributor under all operating conditions.

8. True Misaligned breaker points will burn faster since all the arcing occurs in one small area. The little arc that occurs when the points open is just like arc welding. It's hot enough to melt the contact material and cause them to weld together. You can prove how hot this arc is by tring to run an engine without a condenser (which reduces the arcing). The points will weld together. And don't forget rubbing block alignment; it's also important to long point-life.

9. True How else can you be sure the distributor is working correctly, all the time?

10. True There are other ways to make this test, but either they aren't very accurate or depend on the engine being tested having a nice even vacuum. Most engines aren't that cooperative.

11. True Continuity is essential to any circuit. If resistance of the pickup coil is not within specifications, the pickup coil will not trigger the control unit properly.

12. False The signal produced by the pulse generator is comparatively weak and must be amplified to properly energize the Distributor Tester circuits. The DPA amplifies this signal.

13. True The construction and operation of the mechanical and vacuum advance mechanisms of electronic distributors are identical to standard distributor. Consequently, they are checked using the same procedures.

14. False Prestolite and Chrysler are the only two manufacturers that employ an adjustable air ga

15. True The Prestolite sensor is equivalent to the pickup coil in other systems. This sensor does not produce a signal. It modifies a signal that is generated by the control unit and the vehicle battery. Therefore, an external battery is needed to energize the control unit.

FUEL SYSTEM QUIZ ANSWERS

1. A and C — Fuel mixture and ignition timing and the choke operation and carburetor preheater controls – The amount of CO in the exhaust is always determined by the amount of air and fuel burned in the engine. Anything that affects these amounts causes a change in the amount of CO produced. Improper idle mixture, ignition timing, choke operation and carburetor preheater controls all can upset the mixture and cause a change in CO.

2. C. — Mixture is too lean – As you adjust the mixture leaner, you can reach a point where it becomes too lean to burn properly. When this occurs, you get a "lean mixture misfire" and the unburned fuel causes the HC meter to show an increase.

3. C. — 1% CO. When you briefly accelerate an engine, the CO meter will move toward the right about 1% if the accelerator pump is working properly. If the meter moves toward the left (a lower CO reading) or fails to move right more than 1%, the accelerator pump is not supplying sufficient fuel for good acceleration without hesitation.

4. B. — % CO will increase -- The PCV system allows a small amount of air from the engine's crankcase to leak into the intake manifold. The carburetor is calibrated to supply a small amount of additional fuel to maintain a proper fuel air mixture and CO level. Closing off the PCV system creates a richer mixture, which causes the CO to increase.

5. D. — None of these – CO is made when the air-fuel charge burns. Measuring CO is a way to measure how much air and fuel were mixed together. HC is unburned gas. It is fuel that did not burn due to a misfire or incomplete burning of the fuel.

   In many cases CO and HC will rise or fall together, but this is due to different reasons. Remember, CO changes are caused by mixture or timing changes. HC changes are caused by misfiring or compression losses.

6. D. — None of these – Many fuel injected engines use manifold vacuum as one input to determine how much fuel should be supplied. At 2500 RPM under no load condition you have a condition of fairly high manifold vacuum and high RPM which may fool the injection system into supplying the wrong air fuel ratio. To test these vehicles at high speed, it is necessary to load the engine to simulate road conditions. One way is to test the vehicle on a chassis dynamometer.

7. D. — Carburetor – Most manufacturers specify that this test must be made within 6" of the carburetor's needle and seat.

8. D. — Low volume and no pressure change – The restriction would limit the amount of fuel that could get to the fuel pump thus causing a change in the volume the pump can deliver. The pressure is controlled by the spring inside the fuel pump, so even if only a small amount of fuel gets to the pump the pressure would be good.

9. A. — One pint in 30 seconds – This is just a bit of simple arithmetic. A pint is ½ of a quart and 30 seconds is ½ of a minute.

10. D. — A and B only – The fuel pump pulls or sucks the gas from the tank through the fuel line and into the pump. Should there be any leaks in this line, air would be pulled in and would be seen as bubbles in the fuel during the volume test.